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Review Article

Novel Development of Nutritive, Enhanced Bioactivities, Antioxidant, Antimicrobial, Antiparasitic, DNA Protection and New Insights

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Abstract

Herbal remedies are widely utilized as therapeutic approaches for different medical conditions all over the globe. Various chemical herbicides and pesticides, including the organic and inorganic Sulphur compounds, benzimidazoles, imazalil, and oxidizing compounds, have just been proposed to handle the diseases in plants in recent years to achieve this goal. Anti-inflammatory, antihyperlipidemic, anticancer, and oxidative, analgesics, anorexiant, plasmid curing, and antihyperglycemic properties prominent in medicinal plants. The leaves of another medicinal plant , *Dracocephalum moldavica* have been used for the treatment of stomach and liver disorders, headaches and congestion. Different plants also exhibit the multiple action against variety of microbial pathogens. *Baccharis trimera* used against the infections caused by *Staphylococcus aureus*, *Salmonella gallinarum* and *Escherichia coli*, *Bacillus cereus* strains. Ascorbic acid (vitamin C), carotenoids, tocopherol (vitamin E), and plant phenolic compounds are examples of low-molecular-weight compounds, non-enzymatic anti - oxidants obtained from nutrition. Bilirubin, serotonin, lipoic acid, ketoacids, uric acid, sex hormones, coenzyme Q, and other low-molecular-mass antioxidant chemicals are produced in vivo.

Keywords: Herbal remedies, carotenoids, coenzyme Q, antioxidant, Medicinal plants.

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INTRODUCTION

Medicinal plants have a long history of usage in the treatment of a variety of ailments, including infectious disorders, and hundreds of thousands of plant species have been examined for potential therapeutic characteristics in recent years. Nonetheless, many more plants phytochemical and pharmacological properties need to be investigated. Patients tolerate and absorb organic drugs, which appear to be a trustworthy supply of antibacterial agents. Herbal remedies are widely utilized as therapeutic approaches for different medical conditions all over the globe [1-3]. Most rural populations regard herbal compounded medicines and traditional health methods to be more inexpensive and accessible than contemporary pharmaceuticals. Approximately, over 65 percent of the global population uses herbal remedies for physical and physiological roles and fitness. Furthermore, plants and their derivatives have accounted for roughly 39% of all medications created since 1980 [1, 4, 5].

Microbes such as viruses, bacteria, fungi, and nematodes, and are the disease causing agents in plants that cause a wide range of infections or harm. Particularly, fungi are the primary plant pathogens. In agricultural enterprises across the world, fungi cause significant crop production losses. Fungi that grow on plants, such as *Fusarium spp*., can create mycotoxins that can cause substantial impairment to consumers. In the citrus crop, *P. digitatum* and *P. expansum* induce orange rotting. Mycotoxins include aflatoxin B1 and B2, as well as fumitoxins generated by A. fumigatus and A. flavus[1,4,5].

Chemicals like anti-mycotics are used in agriculture for two purposes: one, to reduce fungal

growth on plants and fruits, and second, to control to avoid or mitigate fruit or plant deterioration after harvesting. Human and animal health is both threatened by the presence and proliferation of this fungus in food and animal nutrition. Off-flavor development and allergenic chemical synthesis are also caused by the establishment of phyto-pathogenic fungus in plants. Most common fungi impacting finer grain crop yields and triggering rotting of containing materials are *Penicillium*, *Fusarium*, and Aspergillus species [6-8].

For fungalinfection prevention, a variety of measures can be used, spanning from specialized farming methods to the production of resistant cultivars. Chemical management is still one of the most effective ways to reduce the spread of crop diseases. Various chemical herbicides and pesticides, including the organic and inorganic Sulphur compounds, benzimidazoles, imazalil, and oxidizing compounds, have just been proposed to handle the diseases in plants in recent years to achieve this goal. Unfortunately, due to the obvious risk of environmental concerns, toxic impacts on human health, the creation of fungus tolerant breeds, and the rather exorbitant prices of such combinations, there has been recent worry regarding their widespread usage. Almost 200 kinds of phytopathogens develop resistance to agrochemicals, according to scientific studies, and the majority of these pesticides entail detrimental consequences [2, 5, 9].

Table-1: Shows the new insights and latest development of some plants characteristics

Medicinals	Action	Role	Significance
H. perforatum	Antibacterial, antihelmintic	Against bacteria and infections	Biomedical , Agriculture
D. bulbifera	Inhibition of oxidative stress	gastric cancer, goiter	Plants, Biomedical
Bogbean	Cancers and oxidative stress	skin disorders	Plants , biomedical
M. trifoliata	Anti-inflammatory	Chronic inflammations	Plants , biomedical
Innovations	Several sets of conservation recommendations	development of protocols for wildlife and flora inventorying and surveillance	for integrated conservation measures based on both in ex – situ technologies

Nutritive, medicinal and Horticultural significance

Essential oils, flavonoids, and sterols abound in the Ziziphora species. Pulegone, a key component of essential oil present in numerous Ziziphora species and with high antifungal and antibacterial action, is absent in *Z. capitata*. *H. perforatum* is a sedative, antibacterial, anti-inflammatory, analgesic, and antihelmintic plant belonging to the Hypericaceae family. Secondary metabolites like tannins, xanthones, flavonoids, and the antibiotic hyperforin are only a few of the bioactive molecules chemicals found in *H. perforatum*. Invasive bacterial infections claimed the greatest number of deaths of people worldwide, as well as in emerging nations. Bacteria, both gram negative and Gram positive, such as *Staphylococcus Bacillus*, Pseudomonas and Salmonella are the most common responsible for serious illnesses in human [10-13].

The leaves of another medicinal plant, *Urtica dioica* have been used for the treatment of diabetic patients as it take the release the stimulation of insulin from the pancreas. It is also used for the treatment of stomach disorders as well as regulation of the physiological processes in case of infectious diseases [14-16]. Its leaves are also used to treat stomachaches as folk medicine. The leaves of another medicinal plant, *Dracocephalum moldavica* L have been used for the treatment of stomach and liver disorders, headaches and congestion. It is also used a source of food components with high nutritive value also used for tea making. *Terminalia chebula* also used as valuable medicinal plant with large range of applications in the treatment of oral diseases gingivitis, stomatitis, etc. Its main phytochemical composition helpful for identifying the large variety of functional compounds acting against the microbial such as dental pathogens [14-17].

Different plants also exhibit the multiple actions against variety of microbial pathogens suh as *Baccharis trimera* used against the infections caused by *Staphylococcus aureus, Salmonella gallinarum* and *Escherichia coli, Bacillus cereus* strains. Since of their diverse natural environments, these creatures have the potential to thrive under difficult conditions. Artificial antibacterial chemicals are limited in the accompanying ways: For instance, they are too expensive for patients from underdeveloped nations. Second, microorganisms acquire drug resistance over time. As a result, many anti-bacterial drugs lose their effectiveness towards bacteria over overtime. Additionally, they may have negative side effects in the body, such as reactivity, immunological inhibition, and allergy symptoms. Herbal compounds, but from the contrary, have had excellent results in functioning like a steppingstone for such development of novel antibiotic agents. Furthermore, antimicrobials developed in just this manner are biologically friendly. Bioactive plant extracts are well known to be a delightful of the preponderance of medications. Berberine (Berberis) and Quinine (Cinchona) are two plant-derived antibiotics that are particularly powerful fighting microorganisms (*Escherichia coli and Staphylococcus aureus*) [12, 15, 17-21].

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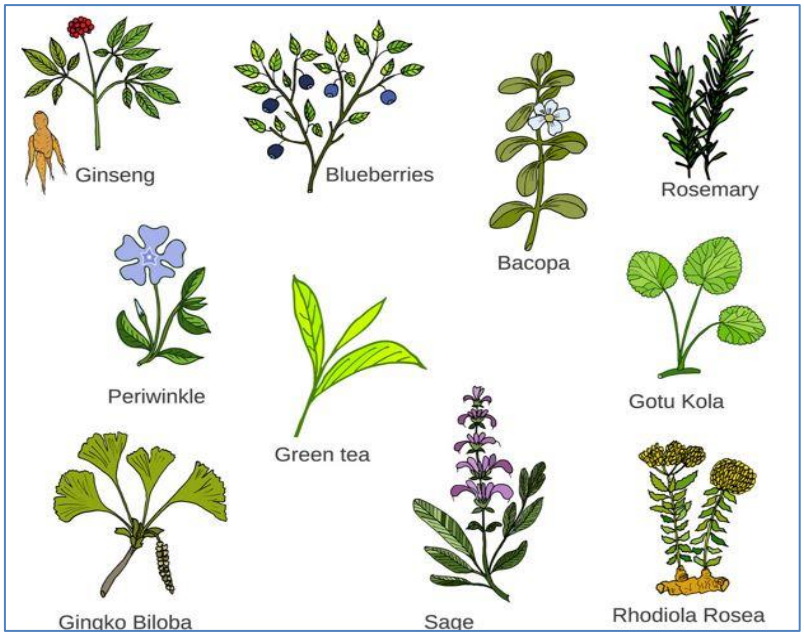

Fig-1: Shows the herbs showing medicinal importance

Role in Oxidative and DNA Protections

Oxidative stress like free radicals and other ROS are catalytically removed by antioxidant enzymes such peroxidases (GPx), superoxide dismutase (SOD) and catalase (CAT). Diminution in enzymatic antioxidants activity diminution has been linked to a variety of diseases. A drop in CAT level has been associated to a decreased capacity of a variety of tumours in detoxifying H_2O_2. Peroxidases operate in a highly competitive to catalases in reducing oxidative stress at low levels, such as protection against H_2O_2. Ascorbic acid (vitamin C), carotenoids, tocopherol (vitamin E), and plant phenolic compounds are examples of low-molecular-weight compounds, non-enzymatic anti - oxidants obtained from nutrition. Bilirubin, serotonin, lipoic acid, ketoacids, uric acid, sex hormones, coenzyme Q, and other low-molecular-mass antioxidant chemicals are produced in vivo[16, 20, 21].

D. bulbifera, often referred as air potato or yam, is a medicinal plant used to cure gastric cancer, rectum cancer, goitre, and sores. Anti-inflammatory, antihyperlipidemic, anticancer, and oxidative, analgesics, anorexiant, plasmid curing, and antihyperglycemic properties have been observed in several bulb extracts [22-25]. The very first thorough mechanisms of G. glauca and D. bulbifera's antidiabetic potential, and also potential applications in nanotechnologies. The importance of phytoconstituents elements in ultimate bioactivity cannot be overstated. In context of this, there's also a rising incentive to understand more about the possibilities among those medically important plants indigenous to Western Ghats of Maharashtra, India.

Phenolics are extensively redistributed in flora and have received a lot of interest in recent years because of strong antioxidative roles and ability to scavenge freeradicals, which could have positive consequences on the health. Antioxidative compounds reduce oxidative stress, delay the generation of hazardous reactive oxygen species, sustain nutritive value, and extend the shelf life of foods when added to them. Such antioxidants may aid in the reduction of oxidative stress, which is the damage caused by free radicals to biomolecules like lipids, proteins, and DNA. Fractions from medicinal herbs, comprising the foliage, branches, root, seeds, and fruits, have been widely researched for their antioxidative properties [24-28]. Nevertheless, several studies have found that synthetic antioxidants have negative side effects such as toxicity and carcinogenicity. Because of customer preference, natural antioxidants are in great demand for usage as nutraceuticals, biopharmaceuticals, and food additives.

Menyanthes trifoliata L., of the Menyanthaceae family, has a lot of potential. Bogbean is a medicinal plant that grows in the temperate zones, primarily in Europe, North America, and Asia's circumpolar northern regions. The leaf decoction treats lack of hunger, fevers, scurvy, and skin disorders in traditional and folk medicine. Through vitro propagation of this plant's tinctures have even been noticed to induce apoptotic cell death in tumor tissues. The biochemical features of M. trifoliata's metabolites have been studied, and the results show that it is a source of polyphenols, a few of which, like phenolic acids, scopoletin, rutin, or loganin, may have medicinal value [29-32].

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In eukaryotic cells, colibactin can cause DNA interstrand crosslinks, cell cycle arrest, and cell senescence (magalocytosis). Furthermore, colibactin promotes DNA alkylation, which forms DNA interstrand crosslinks by binding DNA via a homo-Michael addition process. The complete analysis of colibactin compound is confined to extraction and structural characterizations, and it is harder to identify the formulation of effective medicinal treatments. The current research was crucial in determining the molecular configuration of complete ClbP molecule. Consequently, a fluorogenic activity probe has been developed as a ClbP receptor antagonist for downregulation of colibactin synthesis. Antibiotic drugs such as aminoglycosides, b-lactams, trimethoprimsulfamethoxazole and fluoroquinolones, are also used to treat ExPEC strain infection [13, 18, 20, 22].

Their actions, in particular, can impair cell wall formation and interfere with Gyrase, which is required for DNA synthesis. Antimicrobial drugs, on the other hand, are known to have deleterious effects on normal flora in the human stomach, causing alterations in the resident microflora, which can have major repercussions. The preservation and long-term utilization of therapeutic plants has indeed been extensively researched. Several sets of conservation recommendations have been produced, such as the development of protocols for wildlife and flora inventorying and surveillance, and also the necessity for integrated conservation measures based on both in ex – situ tactics [26, 27, 29].

New insights and latest developments

Sustainable use of wild resources can be an effective conservation alternative for medicinal plants with increasingly limited supplies. Prior to beginning conservation efforts, species rarity is used to assess the extinction risk of medicinal plants and to identify those species that are most at risk of extinction. That's important to figure out how scarce a particular breed is and how they vary from each other. Harvesting pressures have a different effect on different medicinal plants. Overharvesting, arbitrary collections, unrestrained degradation of forests, and loss of habitat often have an impact on biological uniqueness, but they don't fully explain individual species susceptibility or resilience to harvest pressure [4, 9, 16, 18].

Environment specialization, geographical pattern, size of population, biodiversity, rate of growth, and reproductive system are all biological characteristics that correlate with extinction risk. Pharmacological herbal sources are now being gathered in larger quantities, primarily from wild species. In recent decades, demand for natural resource has risen by 8–15 percent each year in Europe, North America, and Asia. There is a point under which a species' reproducing capability is irrevocably lowered. Numerous precautionary measures and recommendations have been put forth for the conservation of medicinal plants, such as providing both in situ and ex situ conservation, have been developed. Seed banks and Botanical Gardens are notable exemplars for ex-situ conservation and future replanting [23, 32-34].

CONCLUSION

Natural reserves and wild nurseries are typical examples of how to keep plants' medicinal efficacy in their natural habitats. The topographical dispersal and ecological properties of medicinal herbs must be studied in order to guide conservation efforts, such as determining whether species conservation should be done in the wild or in nurseries.

REFERENCES

1. Caprioli, T., Martindale, S., Mengiste, A., Assefa, D., H/Kiros, F., Tamiru, M., ... & Kelly-Hope, L. A. (2020). Quantifying the socio-economic impact of leg lymphoedema on patient caregivers in a lymphatic filariasis and podoconiosis co-endemic district of Ethiopia. *PLoS neglected tropical diseases*, *14*(3), e0008058.
2. Chaieb, K., Kouidhi, B., Jrah, H., Mahdouani, K., & Bakhrouf, A. (2011). Antibacterial activity of Thymoquinone, an active principle of Nigella sativa and its potency to prevent bacterial biofilm formation. *BMC complementary and alternative medicine*, *11*(1), 1-6.
3. Cowan, M. M. (1999). Plant products as antimicrobial agents. *Clinical microbiology reviews*, *12*(4), 564-582.
4. Debalke, D., Birhan, M., Kinubeh, A., & Yayeh, M. (2018). Assessments of antibacterial effects of aqueous-ethanolic extracts of Sida rhombifolia's aerial part. *The Scientific World Journal*, *2018*.
5. Aliero, A.A., & Afolayan, A.J. (2005). Antimicrobial activity of 2. Solanum tomentus 3. . Afr. J. Biotechnol. 5: 369-372.
6. Chang, W. T., Chen, Y. C., & Jao, C. L. (2007). Antifungal activity and enhancement of plant growth by Bacillus cereus grown on shellfish chitin wastes. *Bioresource technology*, *98*(6), 1224-1230.
7. Eloff, J.N. (1999). The antibacterial activity of 27 Southern African members of the Combretaceae. *S. Afri. J. Sci*, *95*; 148-152
8. Nielsen, P. V., & Rios, R. (2000). Inhibition of fungal growth on bread by volatile components from spices and herbs, and the possible application in active packaging, with special emphasis on mustard essential oil. *International journal of food microbiology*, *60*(2-3), 219-229.
9. Bhatnagar, D., & McCormick, S. P. (1988). The inhibitory effect of neem (Azadirachta indica) leaf extracts on aflatoxin synthesis inAspergillus

parasiticus. *Journal of the American Oil Chemists' Society*, *65*(7), 1166-1168.
10. Varma, J., & Dubey, N. K. (1999). Prospectives of botanical and microbial products as pesticides of tomorrow. *Current science*, 172-179.
11. Nathan, C. (2004). Antibiotics at the crossroads. *Nature*, *431*(7011), 899-902.
12. Walsh, C. (2003). Where will new antibiotics come from?. *Nature Reviews Microbiology*, *1*(1), 65-70.
13. Silva, N. C. C., & Fernandes Júnior, A. J. J. O. V. A. (2010). Biological properties of medicinal plants: a review of their antimicrobial activity. *Journal of venomous animals and toxins including tropical diseases*, *16*(3), 402-413.
14. Pratap, G. M. S., Manoj, K. M., Sai, S. A., Sujatha, B., & Sreedevi, E. (2012). Evaluation of three medicinal plants for anti-microbial activity. *Ayu*, *33*(3), 423.
15. Rios, J. L., & Recio, M. C. (2005). Medicinal plants and antimicrobial activity. *Journal of ethnopharmacology*, *100*(1-2), 80-84.
16. Locher, C. P., Burch, M. T., Mower, H. F., Berestecky, J., Davis, H., Van Poel, B., ... & Vlietinck, A. J. (1995). Anti-microbial activity and anti-complement activity of extracts obtained from selected Hawaiian medicinal plants. *Journal of ethnopharmacology*, *49*(1), 23-32.
17. Wiyakrutta, S., Sriubolmas, N., Panphut, W., Thongon, N., Danwisetkanjana, K., Ruangrungsi, N., & Meevootisom, V. (2004). Endophytic fungi with anti-microbial, anti-cancer and anti-malarial activities isolated from Thai medicinal plants. *World journal of microbiology and biotechnology*, *20*(3), 265-272.
18. Dabur, R., Gupta, A., Mandal, T. K., Singh, D. D., Bajpai, V., Gurav, A. M., & Lavekar, G. S. (2007). Antimicrobial activity of some Indian medicinal plants. *African Journal of Traditional, Complementary and Alternative Medicines*, *4*(3), 313-318.
19. Rangasamy, O., Raoelison, G., Rakotoniriana, F. E., Cheuk, K., Urverg-Ratsimamanga, S., Quetin-Leclercq, J., ... & Subratty, A. H. (2007). Screening for anti-infective properties of several medicinal plants of the Mauritians flora. *Journal of Ethnopharmacology*, *109*(2), 331-337.
20. Badoni, A. K. (2000). An Ethnobotanical Survey of Pinswari Community-A Preliminary Survey. *Bul Bota Survey India*, *32*, 110-115.
21. Ghosh, S., Ahire, M., Patil, S., Jabgunde, A., Bhat Dusane, M., Joshi, B. N., ... & Chopade, B. A. (2012). Antidiabetic activity of Gnidia glauca and Dioscorea bulbifera: potent amylase and glucosidase inhibitors. *Evidence-Based Complementary and Alternative Medicine*, *2012*.
22. Gao, H., Kuroyanagi, M., Wu, L., Kawahara, N., Yasuno, T., & Nakamura, Y. (2002). Antitumor-promoting constituents from Dioscorea bulbifera L. in JB6 mouse epidermal cells. *Biological and Pharmaceutical Bulletin*, *25*(9), 1241-1243.
23. Antunes, F., Han, D., & Cadenas, E. (2002). Relative contributions of heart mitochondria glutathione peroxidase and catalase to H2O2 detoxification in in vivo conditions. *Free Radical Biology and Medicine*, *33*(9), 1260-1267.
24. Andre, C., Kim, S. W., Yu, X. H., & Shanklin, J. (2013). Fusing catalase to an alkane-producing enzyme maintains enzymatic activity by converting the inhibitory byproduct H2O2 to the cosubstrate O2. *Proceedings of the National Academy of Sciences*, *110*(8), 3191-3196.
25. Mariod, A. A., Matthäus, B., & Hussein, I. H. (2008). Antioxidant properties of methanolic extracts from different parts of Sclerocarya birrea. *International journal of food science & technology*, *43*(5), 921-926.
26. Jadhav, S. J., Nimbalkar, S. S., Kulkarni, A. D., & Madhavi, D. L. (1996). Lipid oxidation in biological and food systems. *Food antioxidants: technological, toxicological, and health perspectives*, 5-63.
27. Ross, J. A., & Kasum, C. M. (2002). Dietary flavonoids: bioavailability, metabolic effects, and safety. *Annual review of Nutrition*, *22*(1), 19-34.
28. Lim, S. H., Jeon, E. S., Lee, J., Han, S. Y., & Chae, H. (2017). Pharmacognostic outlooks on medical herbs of Sasang typology. *Integrative Medicine Research*, *6*(3), 231-239.
29. Blaser, M. (2011). Antibiotic overuse: stop the killing of beneficial bacteria. Nature 476, 393–394.
30. Bossuet-Greif, N., Belloy, M., Boury, M., Oswald, E. and Nougayrede, J. (2017) Protocol for HeLa cells infection with Escherichia coli strains producing colibactin and quantification of the induced DNA-damage. Bio Protoc 7, 1–8.
31. Buc, E., Dubois, D., Sauvanet, P., Raisch, J., Delmas, J., Darfeuille-Michaud, A., Pezet, D. and Bonnet, R. (2013) High prevalence of mucosa associated E. coli producing cyclomod
32. Khan, Mohammad Yaseen, Saleh Aliabbas, Vimal Kumar, and Shalini Rajkumar. "Recent advances in medicinal plant biotechnology." (2009).
33. Vaou, N., Stavropoulou, E., Voidarou, C., Tsigalou, C., & Bezirtzoglou, E. (2021). Towards advances in medicinal plant antimicrobial activity: A review study on challenges and future perspectives. *Microorganisms*, *9*(10), 2041.
34. Jantan, I. (2004). Medicinal plant research in Malaysia: scientific interests and advances. *Jurnal Sains Kesihatan Malaysia*, *2*(2), 27-46.