Ilkogretim Online - Elementary Education Online, 2021; Vol 20 (Issue 6): pp. 5767-5775
http://ilkogretim-online.org
doi: 10.17051/ilkonline.2021.06.558

Prospects And Challenges Of Medicinal Plants Antimicrobial Activity With Special Reference To Moringa Oleifera

Madhumita Sasmal Research Scholar , Department of Microbiology, Sri Satya Sai University of Technology & Medical Sciences, Sehore, M.P., India.

Dr. Syed Shahab Ahmed Research Guide , Department of Microbiology, Sri Satya Sai University of Technology & Medical Sciences, Sehore, M.P., India.

Dr. Ashish Prabhakarrao Lambat Associate Professor , Department of Biology , Sevadal Mahila Mahavidyalaya , Nagpur , M.S. , India.

ABSTRACT:

Moringa oleifera plant is now grown all over the India as well as other countries in the world. It is extensively grown for its incredibly nutrient-dense plant components, which serve as a source of a variety of nutrients, including proteins, vitamins, minerals, phytonutrients like carotenoids, polyphenols, flavonoids, and alkaloids, as well as many other nutrients. This herb has exceptional antifungal and antimicrobial activities. Bioactive compounds found in the plant Moringa oleifera may have antibacterial properties. In this article, prospects and challenges of medicinal plant antimicrobial activity with special reference to Moringa oleifera has been discussed.

Keywords: Medicinal, Plant, Antimicrobial, Moringa oleifera.

INTRODUCTION:

Many tropical and temperate countries, including South and Central America, Mexico, Hawaii, Bangladesh, India, Pakistan, and Bangladesh, are home to the important medicinal plant oleifera. Africa also contains it. The monogenetic organism "Moringa oleifera Lam." is believed to have started in India and is a member of that family. The horseradish tree gets its name from the taste of ground root preparations due to the shape of its young seed pods, while the ben oil tree gets its name from the oils made from the seeds. MO has grown and spread all over Pakistan and India, where it is known as "Sohanjna." In many areas, leaves and immature seed pods are frequently used as staple foods due to their high nutritional value. M. The oleifera plant is also referred to as the "Tree of Life" because it includes almost all of the minerals and amino acids required for human physiology, such as protein, calcium, phosphorus, potassium, sulfur, iron, ascorbic acid, carotene, thiamine, and riboflavin. oleifera tree specifically. Functional food preparations, nutraceuticals, biodiesel production, and the purification of water, roots, leaves, flowers, green pods, and seeds are all beneficial for medicinal reasons.

PROSPECTS AND CHALLENGES OF MEDICINAL PLANTS ANTIMICROBIAL ACTIVITY:

Use of Antimicrobials from Medicinal Plant Extracts:

Antimicrobials made from medicinal plant extracts can offer important therapeutic benefits and more affordable therapy because they are natural, safer than synthetic alternatives, available in local communities, less expensive to purchase, and simple to give. Medicinal plant extracts may also be an effective alternative therapy in instances of severe side effects and drug resistance.

The current percentage of antibacterial compounds derived from medicinal plants that have received approval does not adequately reflect the probability of these compounds being used as antimicrobial therapies in the future. There are some inherent challenges with the use of plant-derived natural products as antimicrobial pharmaceuticals:

- Recent studies have shown that medicinal plant compounds should be used with caution in the absence of trustworthy evidence of their efficacy. Well-controlled, double-blind toxicological and clinical studies proving their efficacy and safety are hard to come by.

- It has been established that the use of medicinal plants is associated with the adulteration of valuable compounds, poor cultivation and collection methods, a lack of standardisation during preparation, and poor storage conditions, all of which have an effect on the process of creating new antimicrobials. The time of year, the region of cultivation, the plant sections used, and the method of processing can all have an impact on the concentrations and actions of various compounds in extracts. It might be challenging to compare the different literature data for the antimicrobial activity of plant extracts because the composition of plant extracts varies based on local climate and environmental conditions. The rainfall and humidity, in particular, can differ significantly from one geographic region to another when the same species of medicinal plant is cultivated there, which can change the production and make-up of the compounds. Additionally, due to global climate change, which alters weather patterns, the composition and production of compounds are at risk even in the same geographic regions.

- It is difficult for scientists to chart all the complex interactions that may have taken place between each and every one of the various compounds found in a medicinal plant. Plant extracts also have the inherent issue of being difficult to interpret due to the large number of various components they contain. Isolating specific compounds with the desired antimicrobial activity could take a lot of effort and plant material. When the same compounds are found from different sources, problems can also occur. Therefore, standardisation, dependability, and quality control are feasible, despite their challenges. However, the chance to examine a large number of unidentified substances might rekindle interest in medicinal plants.

- Synergism among compounds in a complex mixture presents unique difficulties due to the absence of a fully developed technology to study multiple compounds acting on multiple potential biological targets.

- Access management for species of medicinal plants can occasionally be difficult, especially in a global setting. Plant collection and export/import are governed by various laws depending on the study's location.

Innovative Methods for the Preparation of Medicinal Plant Extracts Chemical Compounds:

Extraction involves separating the compounds of plant tissues that are medicinally active from those that are inactive using the appropriate solvents and extraction methods.

A significant number of active compounds have been successfully isolated. However, the success rate and validity of these findings depend on the accuracy of the solvent selection, the choice and proper application of extract methods, the fractionation, and the identification techniques. Therefore, researchers should concentrate on standardizing solvent systems and extraction methods in order to decrease the variation in the results of antimicrobial susceptibility tests (AST). The selection of the solvent is influenced by the kind of plant, the area of the plant that will be used for extraction, the nature of the bioactive chemicals, and the intended use of the extract. The solvent used in the bioassay shouldn't affect the results when assessing antimicrobial substances. The majority of known plant-based antimicrobial substances are aromatic or saturated organic compounds, and they are frequently removed using ethanol or methanol in the beginning. The length of the extraction time, the solvent used, particle size, the ratio of the solvent to the sample, temperature, and pH are all factors that can have an impact on the extraction process. The suitability of extraction methods must be carefully considered in order to guarantee that no bioactive compounds are lost, altered, or destroyed throughout the entire extraction process. The obtained extract may already be suitable for use, or it may go through identification and fractionation to separate out the different components. Through the process of fractionation, which is founded on standard analytical methods using chromatography and hyphenated techniques, plant extracts are divided into various fractions. Finding the functional group, searching for numerous bonds and rings, arranging the hydrogen and carbon, and completely illuminating the structure are all parts of identification. The strategies used incorporate well-known spectrophotometric techniques. One major challenge is the lack of standardised methods to evaluate the antibacterial activity of medicinal plants. For instance, the agar diffusion assay is inappropriate for the quantitative analysis of extracts from medicinal plants because non-polar compounds may not diffuse correctly, leading to false results. Instead, broth microdilution or agar dilution assays should be used to detect the antimicrobial activity of therapeutic plant extracts. There are some advantages to using modern extraction methods, such as relative decreases in the consumption of organic samples and sample degradation, fewer steps, better extraction efficiency, extraction kinetics, and automation simplicity. These methods are proving to be more efficient than the conventional methods.

Determination of Antimicrobial Efficacy of Medicinal Plant Extracts:

The possible antimicrobial efficacy of novel medicinal plant extracts is currently assessed using a variety of evaluation methods. The various ASTs that are used may result in varying results. The selected microorganisms, the methodology used, the growth medium's composition, and the scientific criteria used in choosing the plant material will all have an effect on the outcomes. The most recent standard antimicrobial susceptibility testing methods, which can be broadly classified into diffusion and dilution methods, may not be completely compatible with the use of plant extracts. The primary problem with diffusion and dilution-based AST is the availability of the active principles, which may depend on how soluble the test substance is. Diffusion methods are the qualitative techniques applied in these techniques to ascertain the presence or absence of antimicrobial compounds. Due to their simplicity and ease of use, diffusion tests were frequently used in many investigations, but the absence of standardisation resulted in unreliable and inconsistent findings. Dilution methods are used as quantitative assays to determine the minimum bactericidal concentration (MBC) of antimicrobial agents. These techniques outperform diffusion techniques due to their ability to differentiate between the extract's bacteriostatic and bactericidal effects, their greater sensitivity for smaller extract volumes, their quantitative analysis, and other advantages. Bacteria can be tested very quickly because the assays are conducted using tiny volumes of test antimicrobial in the broth microdilution method. The primary disadvantage of this technique is the extensive manual handling of antimicrobial agent solutions, which increases the risk of preparation errors. Multiple biological isolates can be tested simultaneously with agar dilution, and it also allows for the monitoring of blended populations or cultures. Agar dilution also offers flexibility and freedom in sample selection and concentration range testing. Ultimately, Etest, a state-of-the-art commercial AST that combines the principles of disc diffusion and agar dilution methods, has low variability, yields highly reproducible results, and its performance has been documented as being similar to traditional MIC methods.

The Challenges of Development New Antimicrobials from Medicinal Plant Extracts:

The scientific study of novel plant extracts is challenging due to their enormous intricacy and variability. Because plant extracts can contain hundreds or even thousands of different compounds in varying concentrations, identifying the compounds in them that are responsible for a given biological impact is a significant concern. There are several challenges in developing novel antimicrobials to stop the current spread of antibiotic resistance:

The transition from in vitro studies to in vivo experiments and then to human clinical trials has proven to be the primary challenge in the development of new antibiotics. In vivo research should be done to establish whether the chemical components of medicinal plants can be used as an alternative to or a supplement to the existing methods for treating microbial diseases.

The most careful thought and additional research should only be given to medicinal plant extracts that inhibit microbial growth at low or moderate MIC values.

Extracts' bactericidal capacity lowers the possibility of antibiotic resistance, so it is important to evaluate their MBC.

There is a chance that using the unique traditional knowledge of medicinal plants will result in a lot of biocompatible solutions and hasten the hunt for new antibiotics. The creation of effective and environmentally friendly fractionation technologies is essential for the efficient exploitation of bioactive plant extracts.

The correct interpretation of the results will be made simpler by standardizing the extraction and in vitro testing processes, which will also enable a more methodical search for new antimicrobial drugs from medicinal plants.

Despite the increasing number of compounds isolated from antimicrobial medicinal plants, there are still very few plant-derived medications in clinical use. This may be because complex interactions between components are commonly required for plant compounds to work in concert to increase the activity of the bioactive compound. Numerous studies have shown that the overall activity of plant extracts can be increased by combining substances with additive, antagonistic, and synergistic characteristics. In the production of antimicrobials from medicinal plants, there is a sizable danger of synergism or antagonistic effects because of the complexity of the extract composition.

A comprehensive analysis of synergism within and between plant extracts has shown that the combined effect of plant mixtures is not just the sum of their individual compounds, at least in some cases. However, such combinations might produce adverse consequences that would neutralize any therapeutic benefit. Classifying combination effects within complex mixtures and identifying contributing compounds continues to be a challenging task given that the majority of established tools have been developed to decrease complexity and identify single active compounds in natural product mixtures. Because of this, it's critical to use bioassay-guided or synergy-guided fractionation to identify the compounds or mixtures that are responsible for a particular activity.

Recent developments in metabolomics may greatly facilitate the identification and effective application of newly identified natural antimicrobials. The use of statistical analysis to predict and connect the metabolomic profile of extracts with their bioactivity has grown in popularity. The lack of consensus in the field regarding the ideal reference models for defining combination effects makes it challenging to analyse studies. Recent models that use the specific mean equation and the zero-interaction potency model represent recently developed and trustworthy reference models that could improve the identification of combination effects. Additionally, a number of recently created technologies, such as nanotechnology, bio-adhesive technology, and materials like hydrogel formulations and active packaging, can increase the effectiveness of plant antimicrobial substances.

The development of antimicrobials for oral therapy requires the use of methods that consider how digestion impacts the bioactivity of the extracts. Despite the use of sophisticated in vitro digestion models, it is still difficult to fully reproduce the overall digestive parameters in vivo.

Studies on the toxicity of the majority of potentially useful plant extracts pose a substantial obstacle to their application as antimicrobials. Most compounds have not been evaluated by the United States. Drug Enforcement Administration. It is concerning that there is a dearth of official information regarding the true toxicity of many extracts because the adverse effects caused by improper use of medicinal plants are regarded as a public health problem. Plant extract poisoning is brought on by wrong identification, authentication, and incorrect labelling during standardisation. As a result, the extracts ought to be produced in accordance with stringent guidelines and be governed by legislation.

Another barrier to the production of antimicrobials from medicinal plants is the scarcity of high-quality studies on the understanding of the structure-activity relationship with specific compounds as a consequence of insufficient financial support for research.

Despite challenges, there is a large market for new antimicrobials derived from traditional medicinal plants. The need for novel, effective, less expensive, and safer antimicrobials is a crucial issue for overcoming the aforementioned challenges, including antimicrobial resistance.

The antimicrobial activity of medicinal plants offers fresh promise for warding off the grave threats posed by mounting evidence of antimicrobial resistance. Therefore, it is urgent to identify and purify new bioactive compounds from medicinal plants that have not yet received enough research. The diversity of these substances has shown that they are therapeutically promising both as antimicrobials and as substances that can alter antimicrobial resistance.

Utilizing novel bioactive compounds remains challenging. It is crucial to emphasize that extensive in vitro and in vivo tests must be carried out in order to choose safe and efficient antimicrobial plant-derived compounds. It can be challenging to use the potential synergistic or antagonistic interactions of substances within and among medicinal plant extracts.

ANTIMICROBIAL ACTIVITY WITH SPECIAL REFERENCE TO Moringa oleifera:

The abundance of numerous nutrients in Moringa oleifera tree leaves has led to their widespread use as nutrients and nutraceuticals in recent years. The leaves have only mild antinutritional impacts and are abundant in several healthy chemicals. Numerous in vivo and in vitro studies have lately emphasised the bioactive components and functionality of moringa leaves. Among other health advantages, moringa leaves have anti-inflammatory, antimicrobial, anti-cancer, and anti-diabetic properties. According to research in the literature, the abundance of phytochemicals, carotenoids, and glucosinolates is what primarily causes the majority of these actions.

Moringa is increasingly being used as a value-added ingredient in the preparation of nutritious dishes. Despite extensive study into identifying and quantifying these beneficial components from moringa leaves, bioaccessibility and bioavailability studies are insufficient. The most current studies on the nutritional and bioactive profiles of moringa leaves, as well as on their bioavailability, health benefits, and applications in a variety of food products, are the main emphasis of this study. The nutritional and bioactive profiles, bioavailability, health benefits, and applications of moringa leaves in various food items are all covered in this study's cutting-edge scientific findings. Moringa has been extensively used as a food ingredient that supports good health due to its potent defence against a variety of illnesses and the pervasiveness of environmental contaminants. The use of these leaves, as well as their therapeutic benefits and bioavailability for the creation of different pharmaceuticals and functional foods, still needs further investigation.

The Moringa oleifera Lam (family Moringaceae) is a plant that originated in India and is now grown all over the globe. It is widely cultivated for its extremely nutrient-dense plant components, which are sources of numerous nutrients, including proteins, vitamins, minerals, and phytonutrients like carotenoids, polyphenols, flavonoids, alkaloids. This plant has tremendous antifungal and antibacterial activity. Relevant preclinical and clinical trials, which are in high demand and will require further in-depth study, are also emphasised.

Exhaustive studied claimed that numerous studies have shown a variety of applications for the plant Moringa oleifera such as antibacterial and antimicrobial activity. One approach to its use in food preparation, defining its role as a functional food and its use as a natural additive, is taken by only a small number of review studies focused on food biochemistry and covering sensory acceptance and safety. The bioactive compounds found in the plant Moringa oleifera have the potential to be used as food additives, mainly as preservatives that can halt lipid oxidation and other harmful chemical processes that lead to product degradation. Additionally, it may improve the physicochemical characteristics of the product, thereby improving its quality and shelf life. By increasing the amount of protein, minerals, and vitamins, it also promotes improved nutrition. However, due to the sensory qualities of this plant, consumers only consume fortified products to a limited extent, which presents a problem for the food industry.

Moringa plant is a common species and has a number of benefits. Moringa oleifera L. has been dubbed the "miracle of the tree" because nearly every part of the plant is used by humans, particularly for traditional medical treatments. Moringa has been shown to be helpful as an antibacterial and an anti-inflammatory and is used in items like toothpaste, mouthwash, and chitosan-based root canal irrigation. The potential of moringa plants as antibacterial and anti-inflammatory agents in the oral cavity is examined.

CONCLUSION:

The Moringa oleifera which was developed in India and is now cultivated all over the world. It is widely cultivated for its extraordinarily nutrient-dense plant components, which are sources of a broad range of nutrients, including proteins, vitamins, minerals, and phytonutrients like carotenoids, polyphenols, flavonoids, and alkaloids, as well as many other nutrients. The antifungal and antibacterial properties of this herb are exceptional. The plant Moringa oleifera contains bioactive substances that may have antibacterial properties.

REFERENCES:

1. Kim S.H., Lee S.J., Lee J.H., Sun W.S., Kim J.H. Antimicrobial Activity of 9-O-Acyl- and 9-O-Alkylberberrubine Derivatives. Planta Med. 2002;68:277–281. doi: 10.1055/s-2002-23128.

2. Maiyo FC, Moodley R, Singh M. Cytotoxicity, antioxidant and apoptosis studies of quercetin- 3-O glucoside and 4-(β-D-glucopyranosyl-1→ 4-α-L-rhamnopyranosyloxy)-benzyl isothiocyanate from Moringa oleifera. Anti-Cancer Agents in Medicinal Chemistry. 2016;16(5): 648-656.

3. Iranshahi M., Hassanzadeh-Khayat M., Bazzaz B.S.F., Sabeti Z., Enayati F. High Content of Polysulphides in the Volatile Oil of FerulaLatisecta Rech. F. et Aell. Fruits and Antimicrobial Activity of the Oil. J. Essent. Oil Res. 2008;20:183–185. doi: 10.1080/10412905.2008.9699986.

4. Ghiridhari VVA, Malhati D, Geetha K. Anti-diabetic properties of drumstick (Moringa oleifera) leaf tablets. International Journal of Nutrition and Health Sciences. 2011;2: 1- 5.

5. Lalas S, Tsaknis J. Extraction and identification of natural antioxidant from the seeds of the Moringa oleifera tree variety of Malawi. Journal of Applied Science and Computations. 2002;79: 677-683.

6. Sinha M, Das DK, Bhattacharjee S, Majumdar S, Dey S. Leaf extract of Moringa oleifera prevents ionizing radiation-induced oxidative stress in mice. Journal of Medicinal Food. 2011;14(10): 1167-1172.

7. Mofijur M, Masjuki HH, Kalam MA, Atabani AE, Fattah IR, Mobarak HM. Comparative evaluation of performance and emission characteristics of Moringa oleifera and Palm oil based biodiesel in a diesel engine. Industrial Crops and Products. 2014;53: 78-84.

8. Pandey A., Kumar S. Perspective on Plant Products as Antimicrobials Agents: A Review. Pharmacologia. 2013;4:469–480. doi: 10.5567/pharmacologia.2013.469.480.

9. Kashyap, P.; Kumar, S., H. Recent Advances in Moringa oleifera, Antioxidants and Nature, Vol. 4, No. 1, Page: 34-45, 2018.

10. Moyo B, Masika PJ, Hugo A, Muchenje V. Nutritional characterization of Moringa (Moringa oleifera Lam.) leaves. African Journal of Biotechnology. 2011;10(60): 12925-12933.

11. Sethi N, Nath D, Shukla SC, Dyal R. Abortifacient activity of a medicinal plant “Moringa oleifera” in rats. Ancient Science of Life. 1988;7(3-4): 172-174.

12. Oluduro, A.O.. (2012). Evaluation of Antimicrobial properties and nutritional potentials of Moringa oleifera Lam.leaf in South-Western Nigeria. Malaysian Journal of Microbiology. 8. 59-67. 10.21161/mjm.02912.

13. Mutmainnah Nurul, Achmad Muhammad Harun. Systematic Review of Moringa oleifera's Potential as Antibacterial and Anti-Inflammatory in the Oral Cavity, European Journal of Molecular & Clinical Medicine, 7 (10), 2020, 144-161.

14. Lakshmipriya Gopalakrishnan, Kruthi Doriya, Devarai Santhosh Kumar (2016), Moringa oleifera: A review on nutritive importance and its medicinal application, Food Science and Human Wellness, Volume 5, Issue 2, 2016, 49-56.

15. Mehta K, Balaraman R, Amin AH, Bafna PA, Gulati OD. Effect of fruits of Moringa oleifera on the lipid profile of normal and hypercholesterolaemic rabbits. Journal of Ethnopharmacology. 2003;86(2-3): 191-195.