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The Medicinal Significance of Neem Plant and Saccharomyces Boulardii in Combating Harmful Bacteria

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Abstract:

Due to its strong antibacterial qualities, the neem plant (Azadirachta indica) has been a hot topic in medical study. Bioactive substances like azadirachtin, nimbin, and nimbidin are present in its several components, including neem oil and leaf extracts. Neem is a potent natural antibiotic because these chemicals have antibacterial properties on a variety of dangerous microorganisms. Neem has the potential to fight drug-resistant infections, as evidenced by its capacity to damage bacterial cell membranes, thwart enzymatic reactions, and obstruct bacterial DNA replication.Saccharomyces The Effect of Boulardii on Microorganisms A non-pathogenic yeast called Saccharomyces Boulardii has shown to have significant effects on bacteria, especially in the digestive system. According to extensive study, Saccharomyces Boulardii helps maintain a healthy gut microbiota by preventing the formation of harmful bacteria like Clostridium difficile. Furthermore, the yeast creates secondary metabolites including short-chain fatty acids and antimicrobial peptides that help the body defend itself against dangerous invaders and preserve microbial homeostasis. Neem and Saccharomyces Boulardii's partnership has the potential to decrease the use of chemical disinfectants. In addition to contributing to environmental contamination, the use of these chemical agents can have negative health effects on people. Utilizing the neem and Saccharomyces Boulardii's built-in antibacterial properties, healthcare and sanitation procedures can move toward more environmentally friendly and long-lasting alternatives.

1. Introduction

1.2 Traditional medicine has used therapeutic herbs from the beginning of humanity. It is feasible to synthesize hundreds of chemical components from plants to control insects, fungus, diseases, and herbivorous mammals. Numerous plant chemicals with known or potential biological activity were known, but using a single plant for several different chemicals reduced the efficacy of using the whole plant and prevented accurate scientific research from accurately evaluating the activities related to these substances, which are present in many plants, in order to determine their efficacy and safety. [1].

The Sumerian culture is credited with recording the use of medicinal herbs in history for the first time because hundreds of them, including opium, were listed on clay tablets in the 31st century BC. The Ebers Papyrus, written about 1550 BC in ancient Egypt, had a list of more than 850 medicinal plants. More than 1,000 prescriptions based on more than 600 medicinal plants can be found in the Book of the Five Articles, which was written by the Greek physician Discords while he was serving in the Roman army. This book had been the basis of the pharmacopoeia for more than 1,500 years by the year AD 60. [2].

In order to find pharmacologically active plants, pharmaceutical research depended on popular botanical science. This led to the identification of hundreds of useful compounds, including aspirin, digoxin, quinine, and opium. These substances are present in several plant species, but the majority of them are found in the four biochemical families of alkaloids, glycosides, polyphenols, and terpenes. [3].

A person's identity is shaped by the foods they consume. Or, to put it more accurately, you are being eaten by the millions of trillions of bacteria that reside inside your gut. Like every other surface in your body, the membranes lining your intestines are coated in microscopic organisms, predominantly bacteria. These species make up the microbiome, which is an ecosystem. Although we seldom ever pay attention to it, it is extremely important for maintaining your health and even has the capacity to affect your mood and conduct. It makes reasonable that the foods you consume can have a big influence on how well your

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microbiome works. Additionally, the healthier this system gets, the healthier you will be. The secret to having a healthy microbiome is to keep the diet of the almost 1,000 different bacteria in your gut in balance. There are two ways to maintain this equilibrium: either adding living bacteria directly into your system or helping the already-existing microbes by giving them the nourishment they need (prebiotic). [4].

1.3 Bacteria:

Bacteria are tiny organisms that are omnipresent. Even when we're healthy, they continue to exist on and in our bodies in trillions. Most bacteria are helpful to humans and safe for consumption. Some of them, though, can truly hurt us. Antibiotics work by eradicating the microorganisms that cause bacterial infections like pharyngitis or ear infections. Before the widespread use of antibiotics in the middle of the 20th century, minor injuries like scratches on the knee and infections from small incisions occasionally resulted in mortality.[5].

Skin infections can be brought on by a wide variety of bacteria and can have minor to severe symptoms. As a result, some infections can be treated at home or with over-the-counter medications, but others may require medical attention. [6].

1.3.1 Bioresistance of bacteria:

The first antibiotic, "penicillin," sprang from the depths of nature and has since helped treat millions of illnesses owing to the work of Scottish scientist Alexander Fleming. Penicillin was transformed into a medicine in the 1940s.

After one of the bacteria cultures was poisoned by exposure to air in 1928, the finding was made. The bacteria in the lab culture soon began to dissolve around the fungus, and Fleming surmised that they were secreting a chemical that was harmful to staphylococcal bacteria but not to people or other animals. Penicillin, which means "medicine derived from mold," is the name of the drug.[7].

In order to prevent bacterial overgrowth in humans, antibiotics are often the first line of defense. If symptoms and a patient's medical history indicate to this as the cause, doctors may start this treatment even if test results are unclear or no tests are run. Testing could be done if antibiotic treatment is failed. Short-term antibiotic therapy typically significantly reduces the population of harmful microorganisms. Once the drug is withdrawn, the infection can return, demanding long-term treatment. Some people may take antibiotics less regularly after a mild bowel event, while others may need them more frequently. [8].

Doctors may also alternate between different medications to prevent bacterial resistance. Antibiotics kill the majority of gut flora, both good and bad. Antibiotics may therefore worsen some of the conditions they are meant to treat, such diarrhea. Changing between different medicines could help you prevent this problem. Researchers have discovered a naturally occurring substance present in the bark of some trees that is capable of eradicating drug-resistant bacteria, making it a potentially vital weapon in the fight against superbugs. In a study, scientists from the University of Portsmouth in the UK and Naresuan and Pibulsongkram Rajabhat University in Thailand showed that the medication hydroquinine, which is currently used to treat human malaria, has antibacterial characteristics. [9].

The researchers found that Pseudomonas aeruginosa and other germs, including multidrug-resistant infections, were successfully combated by hydroquinine. Blood infections caused by Pseudomonas aeruginosa also carry a high mortality risk of 30 to 50 percent. According to Dr. Robert Baldock from the University of Portsmouth's Faculty of Pharmacy and Biomedical Sciences, we used bacteria-killing assays to find that hydroquinine was capable of killing a variety of microorganisms, including multidrug-resistant Pseudomonas aeruginosa.[10].

Importantly, I was also found that one of the primary strategies utilized by these bacteria to avoid the fatal effects of the medicine got stronger as the treatment went on, showing a strong response from the bacteria. We anticipate that by researching this molecule further, it may one day provide a new therapeutic route for treating bacterial infections. [11].

1.4 Probiotics and your health:

The membranes lining your intestines are covered in minute organisms, primarily bacteria, just like every other surface in your body. These species make up the ecosystem known as the microbiome. Although we hardly ever pay attention to it, it is essential for maintaining your health and has the capacity to affect your attitude and behavior. It stands to reason that the foods you consume can have a significant impact on how healthy your microbiota is. You will also be healthier the healthier this system is. By dispersing nutrients equitably among the more than 1,000 different bacteria in your gut, you can maintain the health of your microbiome. There are two

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strategies to keep this balance: injecting living bacteria directly into your system (probiotic) or promoting the growth of the germs that are already present [12].

Probiotics are sophisticated plant fibers. Similar to fertilizers, they encourage the growth of bacteria in the intestines.

Prebiotics are present in abundance in many fruits and vegetables, particularly those that include complex carbohydrates like fiber and resistant starch. Because they cannot be digested by your body, these carbohydrates pass through your digestive system where they provide food for bacteria and other pathogens [13].

Prebiotics can be found in a wide range of foods, including helium and yams. Online, there are a ton of examples that are simple to obtain, and we can speak with a licensed dietician. Although there is a wider selection of prebiotic supplements currently, they frequently contain complex carbs like fiber. Companies that sell supplements promote their products as specialized remedies for problems like bone health and weight management while claiming that the supplements' ingredients do so. [14].

In contrast to other dietary supplements, probiotics contain live bacteria or other microorganisms that increase the number of good germs in your stomach. Like prebiotics, you can receive probiotics through food and supplements. The most popular probiotic food is yogurt.

Yogurt is made by fermenting milk with a variety of microorganisms, some of which survive in the final product. Probiotics are also abundant in other bacterially fermented foods including kimchi, kombucha, and sauerkraut. Live microorganisms are also included in probiotic tablets. One dose may contain a single species of microbe or a number of different microbes. Businesses that market probiotic supplements advertise their products for specific ailments like irritable bowel syndrome, similar to how prebiotic supplement companies do. [15].

1.5 Saccharomyces Boulardii:

There is growing evidence that the gastrointestinal microbiota affects the immune system in important ways, not just in the stomach but also in other organs. Saccharomyces boulardii, a nonpathogenic yeast, has been advocated in the past 30 years for both the prevention and treatment of bacterial diarrheal diseases. It is crucial to highlight that S. boulardii has demonstrated clinical and experimental benefit in gastrointestinal problems that mostly involve inflammation, indicating that this probiotic may interfere with cellular signaling pathways that are typical in many inflammatory diseases. The objective of this study is to review the clinical evidence for S. boulardii's efficacy and safety in the prevention and treatment of gastrointestinal disorders with a variety of etiologies. [16].

Probiotic therapies are believed to offer a wide range of potential health benefits. Only a small portion, and even fewer in children, have been demonstrated in carefully designed and carried out randomized controlled trials (RCTs). S. boulardii, a live yeast, is regularly offered as a food supplement and is frequently used as a probiotic. A few of the mechanisms of action that have been identified that affect both the host and pathogenic microorganisms include inhibiting pathogens' capacity to colonize and infect the mucosa, managing local and systemic immune responses, stabilizing the function of the gastrointestinal barrier, and inducing enzymatic activity that promotes absorption and nutrition. [17].

The following are the SACCHAROMYCES BOULARDII efficacy ratings:

- Effective perhaps for: Diarrhea. Ingestion of S. boulardii can shorten a child's bout of diarrhea. It's unclear if it benefits adults or children with persistent diarrhea.
- Perhaps helpful for: • Antibiotic-induced diarrhea (antibiotic-associated diarrhea). Taking S. boulardii orally while receiving antibiotic treatment for adults or kids can help avoid diarrhea.
- A Clostridioides difficile infection of the gastrointestinal system. S. boulardii taken orally seems to help prevent diarrhea brought on by C. difficile infection. It seems to help in reducing the recurrence of this infection when used in conjunction with antibiotics.a stomach infection called Helicobacter pylori, which can cause ulcers. Along with regular H. pylori treatment, taking S. boulardii orally reduces the risk of experiencing adverse effects including nausea and diarrhea. However, it is unclear whether ingesting S. boulardii makes these conventional treatments more effective.• A dangerous intestinal condition that affects preterm babies (necrotizing enterocolitis or NEC). The majority of studies demonstrate that administering S. boulardii to preterm babies orally avoids NEC.
- Diarrhea rotavirus-related. S. boulardii appears to lessen the length of rotavirus-induced diarrhea in children when administered orally.

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- The traveler's stomach. Oral S. boulardii dosing seems to reduce the likelihood of developing diarrhea when traveling.

Potentially unhelpful for: • Sepsis, a blood infection. When S. boulardii is given orally to premature babies, sepsis cannot be prevented.

S. boulardii is being considered for a number of additional uses, but there is insufficient proof to say whether or not it will be advantageous.. [18].

Probiotics are renowned for their wealth of health advantages for the body in general, the digestive system in particular, and overall health. The term "probiotic" describes living, helpful bacteria that can be found in some meals, drinks, and dietary supplements. These helpful bacteria resemble the helpful bacteria that are found in the human body naturally.

Therefore, one of the advantages of probiotics is their contribution to the body's beneficial bacteria, which helps it perform vital tasks like maintaining intestine movement, finishing digestion, absorbing nutrients, and boosting the body's ability to fight off infection. [19].

Yeast boulardii has 10 times more surface area than probiotic bacteria.

* Boulardii Junior Probiotic removes bacteria and viruses that cause diarrhea from the body by binding a lot of them to itself thanks to its huge surface area.

Salmonella, Clostridium difficile, and other bacterial toxins can only be broken down by yeast Boulardii. Toxin reception sites are blocked by the probiotic boulardii, which also prevents the toxins' damaging effects on the mucosal membrane of the gastrointestinal tract by secreting proteases that break down bacterial toxins.

A fungus called yeast boulardii has a built-in capacity to withstand the effects of antibiotics.

*The sole boulardii probiotic on the market that can be taken with antibiotics.

IgA antibodies and immunological factors are secreted by the gut in response to Boulardii strains.Boulardii Junior probiotic enhances the digestive system's resistance to infection and immunity.

1.5.1 The elements influencing Saccharomyces boulardii's probiotic efficiency:

S. boulardii's probiotic effectiveness is influenced by a number of factors, including the inherent properties of the yeast, its pharmacokinetics, product to product variability, stability, the number of strains used in the probiotic formulation, and the amount of probiotic used.

There are numerous unique Saccharomyces products commercially available and sold as probiotics, and S. boulardii is frequently provided in capsule form of either lyophilized or heat-dried preparations. The choice of a high-quality probiotic product is one of the factors that significantly influences how beneficial probiotics are. The quality of these commodities from different sources could vary, and many commercially available goods might not have formal quality control processes in place. The product's effectiveness may differ even though the label says it contains S. boulardii due to a lower dosage than stated or an inaccurate strain composition. Choosing high-quality probiotic products may be difficult without access to rigorous quality control tests for commercially available probiotic products. Buying products from producers who support first clinical trials may demonstrate a higher commitment to creating high-quality products. [20].

The stability of the probiotic product may have a significant impact on its efficacy over time. Lyophilized goods are lightweight, stable at room temperature, and maintain high viability rates for long periods of time. Preparations that have been heat-dried need to be preserved in the fridge because they might not be stable at room temperature. According to a study of the bacterium, a lyophilized product outperformed three heat-killed S. boulardii preparations in terms of pharmacokinetics and had more viable cells. [21].

Using a single-strain preparation, S. boulardii was employed in every RCT that tested it. Probiotic mixes including S. boulardii are available on the market, however no RCTs have been done to show that these blends are better than therapy with a single strain. S. boulardii is one of several probiotic combinations that have showed potential in preclinical studies using animal models. However, any rivalry between the various probiotic strains may lessen their curative effects. [22].

Last but not least, the quantity of S. boulardii used can affect how effective this probiotic is. The variable dosages of S. boulardii used in the various research may help to explain some of the discrepancies in the efficacy and outcomes between these investigations. In some studies, the amount of S. boulardii used is reported inconsistently across investigations (e.g., number of organisms per 100 ml, number of organisms per day, colony forming units [cfu] per day, or grams per day). Unfortunately, the amount of S. boulardii used is not consistently

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documented in all trials. This variation prevents meta-analyses and more investigation into how S. boulardii dosage impacts its efficacy from being conducted. [23].

Azadirachta indica, sometimes known as neem, nimtree, or Indian lilac, is a species of mahogany tree in the Meliaceae family. It is one of only two species in the genus Azadirachta and a native of the Indian subcontinent. It is typically grown in tropical and semi-tropical settings. Neem trees can also be found on islands in southern Iran. Fruits and seeds of the plant are used to make neem oil. The neem tree grows quickly, but it rarely reaches a height of 35 to 40 meters (49 to 66 feet) (115–131 ft). It loses a lot of leaves in the dry winter because it is a deciduous plant. The branches reach out and are broad. The rather rounded, moderately dense crown can have a diameter of 20–25 meters (66–82 ft). The neem tree is comparable to the chinaberry, which is its related in look (Melia azedarach)[24].

The opposite, pinnate leaves are 20–40 cm (8–16 in) long and have 20–30 leaflets that are 3–8 cm (1+1/4–3+1/4 in) long and medium–dark green in color. The terminal leaflet is frequently missing. The petioles are short. There are axillary panicles that can grow up to 25 cm (10 in) long and are somewhat drooping with white, fragrant blooms. The inflorescences, which branch up to the third degree, can support 250 to 300 blooms. A single blossom has a width of 8-11 mm (5.16-7.16 in) and a length of 5-6 mm (3.16-14 in). Protandrous, bisexual, and male blooms can all be found on the same particular tree. [25].

The fruit, which is an elongate oval to nearly spherical drupe and is smooth (glabrous) when ripe, is 14–28 mm (1-2–1+18 in) by 10-15 mm (3–8–58 in) in size. Fruits feature a thin exocarp and a bitter-sweet, yellowish-white, extremely fibrous mesocarp. Mesocarps can be between 3 and 14 inches thick (3-5 mm). The white, hard endocarp of the fruit contains one, two, or even three elongated seeds (kernels) with a brown seed coat. Sometimes people confuse the neem tree with the bakain tree because of how similar they seem. Similar-looking fruit can also be found on bakain, which also has serrated leaves. Bakain leaves are twice- and three times-pinnate compared to neem leaves, which are pinnate. [26].

1.6 Phytochemicals

Neem fruit, seeds, leaves, stems, and bark all contain a variety of phytochemicals; some of these substances were first discovered in azadirachta seed extracts, including azadirachtin, which was first utilized as an insecticide and antifeedant in the 1960s. 2 kg of seeds must be crushed in order to yield 5 g of azadirachtin. In addition to azadirachtin and associated limonoids, the seed oil contains glycerides, different polyphenols, nimbolide, triterpenes, and beta-sitosterol. The yellow, bitter oil has a garlic-like scent because to limonoid compounds, which make up about 2% of its chemical makeup. The leaves contain quercetin, catechins, carotenes, and vitamin C. [26].

1.7 Traditional medicine

Despite the fact that neem tree products have been used in Indian traditional medicine for many years, there is not enough clinical evidence to back up their effectiveness. While no specific doses have been established for humans, short-term use of neem appears to be harmless, long-term use may have negative effects on the kidneys or liver, and neem oil is toxic and potentially lethal for small children. Neem also causes low blood sugar, infertility, and miscarriages as side effects. The entire tree, including its leaves, blooms, seeds, fruits, roots, and bark, has been used in traditional medicine to treat a wide range of diseases, including inflammation, infections, fever, skin concerns, and dental issues. The healing properties of neem leaves have received significant attention. [27].

1.8 Control of pests and diseases

Neem plays a key role in non-pesticidal management (NPM), a safe alternative to synthetic pesticides. Neem seeds are ground into a powder, which is then diluted with water and sprayed on crops. To be effective, it must be used frequently—at least once every 10 days. Neem does not instantly kill insects. It serves as an anti-feedant, repellent, and egg-laying deterrent, preventing damage to the crop. The insects starve to death in a short period of time. Neem also stops the eventual hatching of their eggs. Neem-based fertilizers have been found to be effective at preventing southern armyworm. Neem cake is a fertiliser you can use. Neem oil has been shown to be a practical and environmentally friendly treatment for termite prevention assault. [28].

1.8.1 Polymeric resins with neem oil

Neem oil is used to make polymeric resins, according to recent research. According to the claim, neem oil can be utilized to make a variety of alkyd resins using a monoglyceride (MG) technique, which can then be used to make PU coatings. The alkyds are produced by mixing

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MG of neem oil with the conventional divalent acid components, such as phthalic and maleic anhydrides. [29].

1.9 Biotechnology

The biopesticide generated from tree seeds contains limonoid triterpenes. The extraction method currently has limitations such fungal contamination and heterogeneity in limonoids content because of genetic, environmental, and regional variability. Research on the biosynthesis of limonoids from plant cell suspension and hairy root cultures has addressed these problems, leading to the development of a two-stage bioreactor technique that enhances growth and limonoids production utilizing A. indica cell suspension cultures. [30].

2. Conclusion:

The potential of this combination strategy is highlighted by the therapeutic importance of the neem plant in battling pathogenic bacteria and the amazing effects of Saccharomyces boulardii on microbial equilibrium. Neem and Saccharomyces Boulardii work together to provide a beneficial alternative to chemical disinfectants that is less harmful to the environment and better for human health. Adopting these natural cures demonstrates a progressive attitude toward medical care and environmental protection.

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