iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 13 **Issue:** III **Month of publication:** March 2025

DOI: https://doi.org/10.22214/ijraset.2025.67685

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.538
Volume 13 Issue III Mar 2025- Available at www.ijraset.com

Antimicrobial Property of Thespesia Populnea Root Extracts against Genitourinary Tract Infectious Pathogens

Pradeesh.S[1], Darshan.M[2], Mythreyan.B[3], Aanandha kumar.G[4], A.M.Ramachandran[5], J.Rengaramanujam[6], J.Devakumar[7], R.Mahenthiran[8]
Dept of microbiology, Dr.N.G.P Arts and science college Coimbatore 641048

Abstract: ***The healing properties of plants have been utilized by humans from ancient times to the present in order to combat infections and avert illnesses. Thespesia populnea is a member of the Malvaceae family and is located in coastal and tropical areas of India as well as in arid soil regions. The plant is versatile, with all its components, including roots, leaves, bark, stem, flower, and fruits, employed for their anti-microbial, anti-oxidant, anti-inflammatory, and anti-fertility attributes. The plant extracts are obtained using various solvents such as ethanol, methanol, water, and ethyl acetate to test their anti-microbial efficacy against urinary tract infections. Phytochemical analysis revealed the presence of alkaloids, terpenoids, and tannins.***
Keywords: Thespesia populnea, root, extracts, antimicrobial property, urinary tract infections

I. INTRODUCTION

Plants serve as significant sources of anti-microbial agents utilized for research purposes and as medically beneficial plants applicable in traditional medicinal practices. Numerous screenings for medically beneficial therapeutic biomolecules have been conducted, and these bioactive components are recognized by the World Health Organization (WHO), highlighting the importance of medically beneficial plants. Thespesia populena has been utilized for extraction methods that promote safe and effective healthcare for a large number of individuals suffering from urinary tract infections (UTI) [parle et al. , 2006].

Thespesia populena and its therapeutic activity for UTI patients: This extraction technique is applicable to all types of plant body parts, including leaves, stems, bark, roots, wood, flowers, fruits, and seeds. Therefore, it is vital to consider the preferred forms; all parts address both traditional and modern health care systems, utilizing therapeutic agents effectively for healing.

The leaves are primarily utilized for their anti-inflammatory effects and are involved in phytochemical investigations, extraction techniques, and indicators used for compounds such as lupeols, lupenone, gossypol, and beta-sitosterol. These extraction products are chiefly aimed at components that contribute to anti-inflammatory, anti-fertility, and beneficial effects for humans, while the fruit contains beta-sitosterol and ceryl alcohol, as well as a yellow pigment associated with Thespesia populena.

Traditionally, the plant is utilized for its medicinal properties, demonstrating actions such as anti-fertility, antioxidant, purgative, and hepatoprotective effects in its bark, wood, leaves, flowers, and fruits, which can assist in treating ringworms, guinea worms, scabies, and Alzheimer's disease for enhancing memory treatment. Antioxidant and hepatoprotective actions, along with wound healing activity, form the primary objectives of current studies investigating antibacterial, antimicrobial, and antifungal activities of leaf extracts, with whole plant samples collected from Tamil Nadu, India [Baron et al. , 1990].

Thespesia populena leaf: The leaves of Thespesia are heart-shaped, green, and generally range from 5 to 10 cm in length. They exhibit small scales on both surfaces and feature distinct yellow veins. The leaves are spirally arranged on the stem and possess stalks. Their texture is leathery, giving them a substantial feel. Chemically, the leaves contain beta-sitosterol, a plant sterol recognized for its nutritional and medicinal properties. This compound, alongside other plant sterols, contributes to the potential health advantages of the leaves.

II. BETA-SITOSTEROL'S ROLE IN UTI

Anti-inflammatory: Beta-sitosterol may lessen inflammation and may assist in easing symptoms of UTI and encourage healing. Anti-inflammatory agents act in various manners to inhibit inflammation, which assists in regulating the rate of protein synthesis, diminishing lymphocyte proliferation, stabilizing the membranes of cells, and lysosomes, the organelles within cells that hold digestive enzymes, and enhancing pulmonary microcirculation.

Immunodulatory: It can affect the immune system and improve the body's capacity to combat infections and promote healing. Immunomodulators can either activate or inhibit the immune system. When an immunomodulator activates, it provides your immune system with the necessary support to enable it to respond to an illness or disease like inflammatory bowel disease (IBD), allergic conditions, and infections. [Lyne et al. ,1995].

Antioxidant: It neutralizes free radicals within the body and decreases oxidative stress to bolster the immune system, aiding it in warding off infections. Antioxidants may prevent some of the damage inflicted by free radicals that can result in cancer. Antioxidants might assist in reducing your risk of AMD by as much as 25%. In the skin, it enhances the barrier against UV and diminishes the visibility of dark spots.

Flower: The flowers of Thespesia are bell-shaped, featuring five broad, round, oblique petals. Initially pale yellow at the center, they change to pink or purple-pink as they mature. The flowers measure roughly 7. 5 cm in diameter. The pedicels are thick, measuring between 1. 3 to 5 cm in length, and the calyx is cup-shaped, green, and about 10 mm long. The stamens are arranged on a column and approximately 2. 5 cm long. The pistil comprises a five-celled ovary with a slender style and five broader stigmas. The flowers also contain various chemical constituents, such as populenol, tannins, phytosterols, terpenes, and gums and mucilage, which contribute to their medicinal and nutritional benefits.

Populenol: Exhibits anti-bacterial, anti-inflammatory, and antioxidant properties.

Phytosterol: Demonstrates anti-adhesion and synergistic effects. Phytosterols compete with dietary cholesterol for specific enzymes required for their metabolism. This can decrease cholesterol absorption by a significant 30–50%. Test-tube and animal investigations similarly suggest that phytosterols could possess cancer-fighting capabilities and may slow tumor growth and spread. A high intake of phytosterols may be associated with a reduced risk of stomach, lung, liver, breast, prostate, and ovarian cancer.

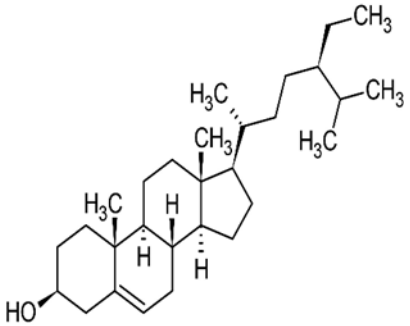
Gum and mucilage: Function as a protective barrier and possess diuretic effects.

Bark: The bark of Thespesia is smooth and gray in hue, exhibiting a slightly scaly and flaky texture. It has a thickness ranging from 4 to 6 mm, providing a sturdy outer layer. The bark contains triterpenoids, a class of chemical compounds noted for their medicinal and therapeutic properties, which add to the plant's overall potential health benefits. Triterpenoids: Act against biofilm formation and modulate the immune response. Triterpenoids from plants have proven effective in reducing inflammation. Triterpenoids have been observed to inhibit tumor progression by activating the intrinsic apoptosis pathway. Asiatic acid has been studied for its potential to enhance passive avoidance memory and learning but did not influence active avoidance memory in animal studies. [Owens et al. ,2000].

Stem: Thespesia is a medium-sized tree that reaches a height between 6 to 10 meters. Its twigs are initially adorned with brown to silvery scales, which fade away as the tree develops. The tree exhibits a broad crown with branches that extend outward. The tree's parts are recognized for their properties related to wound healing, antidiabetic effects, and antidiarrheal functions. The root system consists of a taproot that grows straight down, while lateral roots branch out from the main root to the smaller roots, efficiently absorbing nutrients from the soil. The root bark is thick and fibrous, appearing in colors ranging from grayish-brown to brownish-black, and is noted for its astringent characteristics.

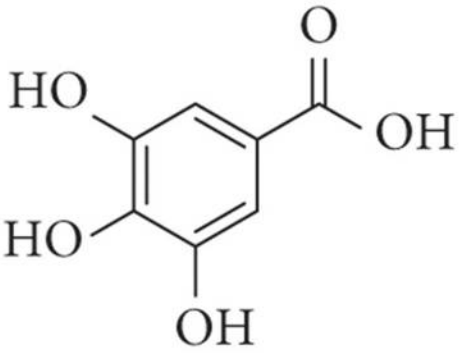
Astringent: Alleviating inflammation and drying excess mucus in the urinary system. The main advantages consist of reducing acne, firming the skin, minimizing and unclogging pores, cutting down oil production, and purifying the skin. Natural astringents may offer numerous anti-inflammatory, antifungal, and therapeutic benefits.

Phytochemicals present in Thespesia populena:



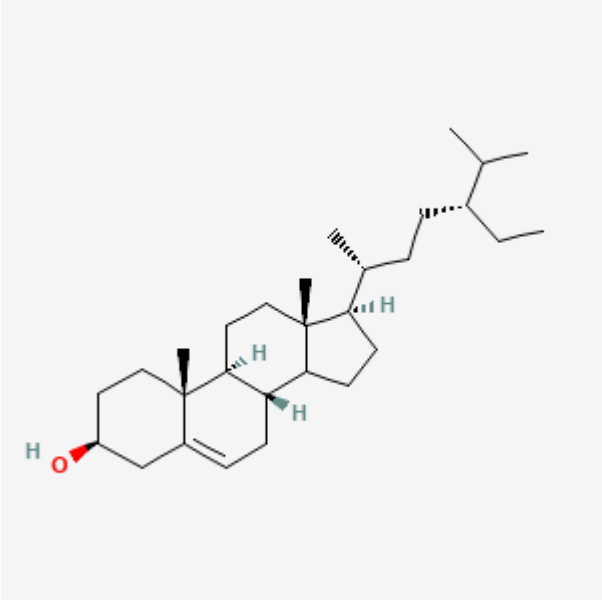
Source:https://www.abcam.com/beta-sitosterol-antitumor-agent-ab143122.html

Antioxidant:



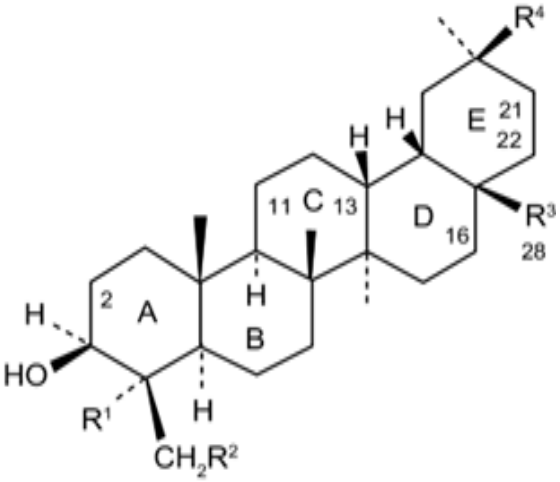
Source:https://www.researchgate.net/figure/Structural-formula-of-some-molecules-with-antioxidant-properties-used-as-reference_fig2_347546455

Phytosterol:



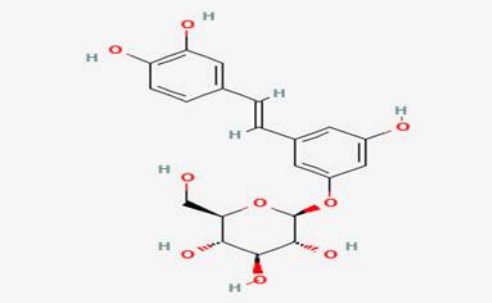
Source:https://pubchem.ncbi.nlm.nih.gov/compound/Phytosterols

Triterpenoids:



Source:https://animalia-life.club/qa/pictures/triterpenoid-structure

Astringent:



Source:https://pubchem.ncbi.nlm.nih.gov/compound/Astringin

Urinary tract infections (UTIs):

UTI is a prevalent infection that occurs more frequently in females than in males, affecting 1 to 2% of children. The bacteria responsible for 90% of these infections is E. coli, which is found in the gut microbiome. It ascends to the kidneys through the uterus when unclean hands come into contact with the urinary system. The urinary tract includes the kidneys, uterus, urethra, and bladder. UTI primarily causes inflammation of the linings in the urinary tract; some symptoms include abdominal and pelvic pain, pain during urination, the urgency to urinate, urinary incontinence, a foul odor, fever, fatigue, chills, and confusion, among others. [Mohan et al. , 2011].

Thespesia populena role in UTI:

The extract of Thespesia populena was derived using various extraction techniques. The identified compounds included saponins, flavonoids, tannins, carbohydrates, and reducing sugars. These compounds were evaluated against different microbes that may lead to UTI infections. The entire plant possesses antioxidant, anti-microbial, anti-inflammatory, populenol, astringent, and beta-sisterol properties, which aid in alleviating symptoms and treat the infection with minimal side effects on the human urinary system. [Patil et al. , 2012].

Saponins: Saponins have anti-inflammatory characteristics that alleviate pain during urination and exhibit antimicrobial properties that reduce microbial load. They neutralize harmful free radicals that can damage cells, potentially leading to chronic conditions such as heart disease or cancer. Due to their distinctive ability to modulate immune system functions and target tumor cells, saponins represent a promising research area for cancer prevention and treatment.

Tannins: Tannins play a crucial preventive role by inhibiting the adhesion of bacteria in the body, soothing the urinary tract lining, and providing anti-inflammatory effects. Tannins may also possess antimicrobial benefits that improve gut health, and they can help alleviate inflammation in the body. Some tannins have been linked to a lower risk of heart disease.

Populenol: It is present in the plant and has anti-diuretic effects that aid in flushing bacteria out of the body through urinary flow.

Astringent: Astringent aids in the contraction of inflamed tissues and reduces swelling and irritation in the urinary tract. The whole plant contains numerous herbal and chemical compounds that can be harnessed for various health-related issues. However, it is primarily utilized in this context for the prevention and treatment of UTI and associated concerns, with a specific emphasis on pre- and post-care.

Other applications of Thespesia populena:

Anti-inflammatory:

Anti-inflammatory or antiphlogistic refers to a characteristic of a substance or treatment that diminishes inflammation or swelling. These medications alleviate pain by mitigating inflammation in contrast to opioids, which influence the central nervous system to inhibit pain signals to the brain. Beta-sitosterol may lessen inflammation and may assist in alleviating symptoms related to cancer prevention and treatment primarily by enhancing apoptosis, inducing cell cycle arrest, bidirectionally regulating oxidative stress, improving metabolic reprogramming, inhibiting invasion and metastasis, and modulating immunity and inflammation.

Antipyretic:

An antipyretic (from anti- 'against' and pyretic 'feverish') is a compound that reduces fever. Antipyretics prompt the hypothalamus to override a prostaglandin-induced rise in temperature. The body subsequently works to decrease the temperature, resulting in a reduction of fever. The antipyretic assessments are conducted in mice by injecting acute arthritis in the left hind leg of mice to evaluate the antipyretic effects.

Antidiabetic:

An antidiabetic is a compound that aids in controlling blood sugar levels in individuals with diabetes mellitus. These compounds function by either boosting insulin production, enhancing insulin sensitivity, decreasing glucose absorption, or diminishing glucose production in the liver. Flavonoids: Quercetin – Increases insulin sensitivity and has antioxidant attributes. Kaempferol – Aids in regulating glucose metabolism. Tannins: Recognized for inhibiting α-amylase and α-glucosidase enzymes, which assist in slowing carbohydrate digestion and glucose absorption.

Phenolic Compounds: Thespesia comprises various bioactive compounds that contribute to its medicinal attributes. Gallic acid, recognized for its antioxidant benefits, helps protect pancreatic β-cells, which are vital for insulin production. Ellagic acid promotes glucose uptake and stimulates insulin secretion, further aiding in healthy blood sugar regulation. The alkaloids found in the plant help stimulate insulin release and decrease blood sugar levels. Furthermore, saponins are acknowledged for enhancing glucose uptake in muscle cells and improving insulin sensitivity, making these compounds beneficial in managing conditions such as diabetes. Terpenoids: Have been noted to exhibit hypoglycemic effects by enhancing glucose metabolism.

The mechanism of Thespesia populena encompasses:

Stimulating insulin secretion from pancreatic β-cells. Enhancing glucose uptake in peripheral tissues. Inhibiting carbohydrate-digesting enzymes to lower postprandial blood sugar levels. Reducing oxidative stress, thereby protecting β-cells from damage.

Ameliorative effects:

Thespesia populena contains flavonoids (quercetin, kaempferol) and phenolic compounds (gallic acid, ellagic acid) that neutralize free radicals, preventing cardiac cell damage. Bioactive compounds in Thespesia populnea diminish pro-inflammatory cytokines (such as TNF-α and IL-6), reducing vascular inflammation and safeguarding heart tissues. Thespesia populnea has been discovered to reduce LDL cholesterol and triglycerides, preventing atherosclerosis, and increase HDL (good cholesterol), which aids in removing excess fats from blood vessels. [Barry et al. ,1981].

Thespesia populnea contains substances that enhance vasodilation (the expansion of blood vessels), leading to lower blood pressure. It boosts nitric oxide (NO) production, which relaxes blood vessels and decreases resistance to blood flow. The polyphenols and flavonoids present in Thespesia populnea assist in protecting heart muscles by inhibiting cell death (apoptosis) and minimizing fibrosis (the scarring of heart tissue). Thespesia populnea possesses antiplatelet and anticoagulant characteristics, which help in thwarting unnecessary blood clots from forming. Its properties include antioxidant, anti-inflammatory, lipid-lowering, and vasoprotective effects. Thespesia provides numerous cardiovascular advantages, such as preventing atherosclerosis by decreasing plaque accumulation in the arteries. It aids in lowering blood pressure and enhancing circulation, thereby supporting overall heart health. The plant also helps in reducing cholesterol and triglyceride levels, crucial elements for sustaining a healthy cardiovascular system. Furthermore, it safeguards heart muscles from oxidative stress and damage, which further bolsters heart function. By diminishing blood clot formation, Thespesia may also reduce the likelihood of heart attacks, making it a beneficial natural remedy for heart health.

III. CONCLUSION

The phytochemical analysis of Thespesia populnea revealed various types of compounds, primarily flavonoids, phenols, steroids, saponins, and tannins. This plant comprises a total of 15 bioactive compounds. Carotenoids and flavonoids were found to be alkaloids and demonstrate significant antimicrobial potential for treating UTIs, rendering this plant a comprehensive source of medicine for numerous infections. The extract from the plant inhibits microbial growth in the urinary tract and can be processed to discover more new drugs. [Hopkins et al. , 1999]. The ethanolic leaf extract and petroleum ether fraction of Thespesia populnea show significant promise as natural treatments for Alzheimer's disease, backed by preclinical evidence of their antioxidant, neuroprotective, and acetylcholinesterase inhibitory capabilities. It is suggested that ethanolic bark and wood extracts undergo further similar studies in future research, as they may contain active compounds that could assist in treating symptoms of Alzheimer's disease. [Das et al., 2010].

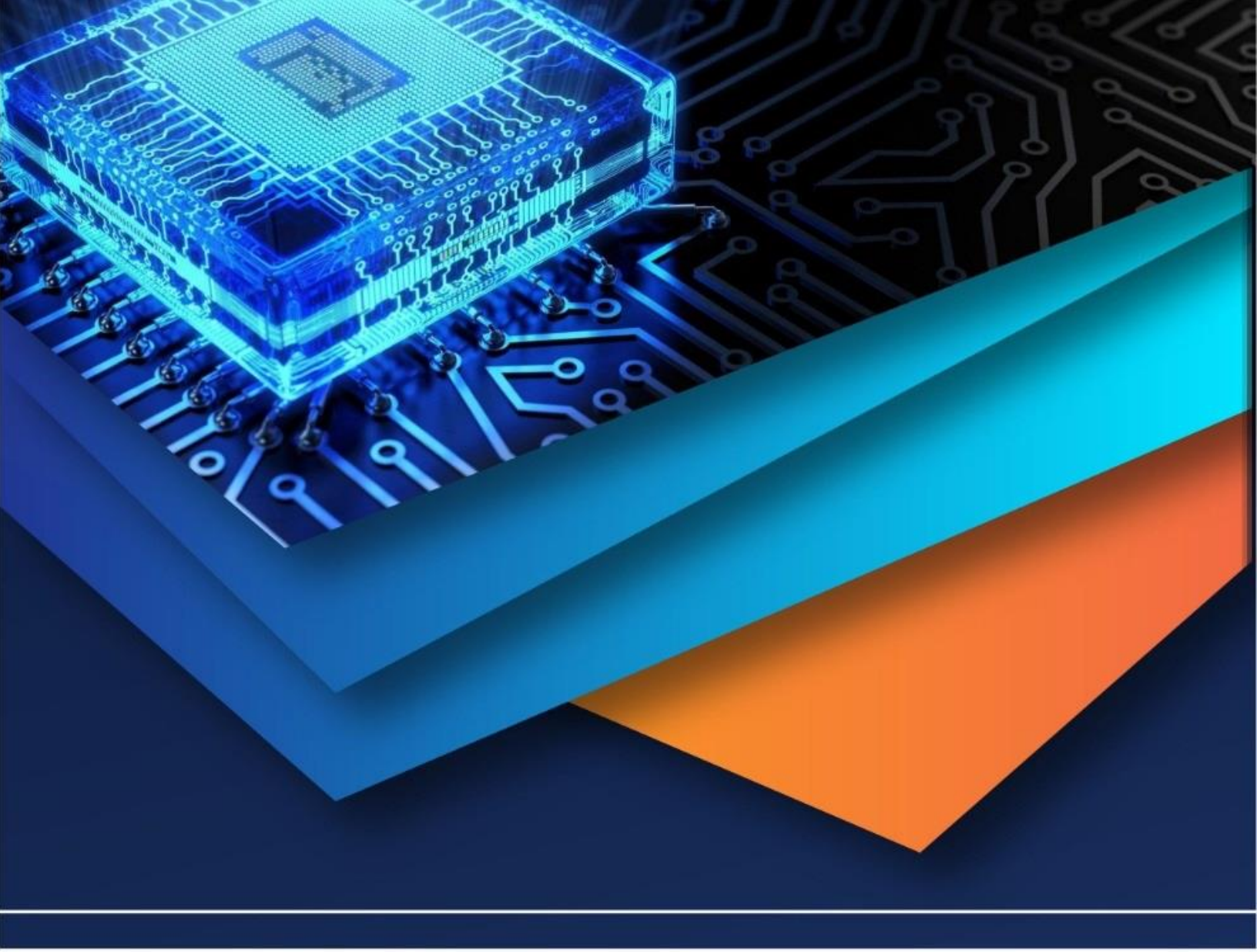
IV. ACKNOWLEDGMENT

The author thanks to DBT Star Status Scheme, DBT, Govt. Of India and Dr.N.G.P Arts and Science College, Coimbatore, Tamil Nadu, for providing necessary support for this review and chapter work.

REFERENCES

[1] Vasudevan, M., & Parle, M. (2006). Pharmacological actions of Thespesia populena relevant to Alzheimer's disease. Phytomedicine, 13(9), 677-687
[2] Akhila, S. & Rani, K. (1993). Biosynthesis of gossypol in Thespesia populnea. Phytochemistry, 33, 335-340

[3] Baron, E. J. & Finegold, S. M. (1990). Baileyand Scotts. Diagnostic Microbiology. 8Edn., Mosby, USA. 176-182
[4] Ismail, A., Marjan, Z. M., Foong, C.W. (2004). Total antioxidant activity andphenoliccontent in selected vegetables. Food Chemistry, 87, 581-586
[5] Collins, C. H., Lyne, P. M. & Grange, J. M. (1995). Microbiological Methods, 7thEdn, Butterworths, London, 133
[6] Trease, G. E., & Evans, W.C. (1983). Textbook of pharmacognosy. (12th Ed.). English society Bartex, pp.73-86
[7] PJ Jones. CMAJ. (2002), 166, 1555-1563
[8] Frank D. Popp. (1962). J. Med. Chem. 5(3), 627-629
[9] Owen, R. W., Giacosa, A., Hull, W. E., Haubner, R., Spiegelhalder, B. and Bartsch, H. (2000). Eur. J. Cancer. 36(10), 1235-47
[10] Maruthupandian, A., and Mohan, V. R. (2011). Int. J. Chemtech. Res. 3(3), 1652-1657
[11] Maizura, M., Aminah, A., Wan Aida, W. (2011). Total phenolic content andantioxidant activity of kesum (Polygonum minus), ginger (Zingiber officinale) and turmeric (Curcuma extract, International Food longa) Research Journal, 18, 529-534
[12] Patil, P. S., Venkatanarayanan, R., Argade, P. D., & Shinde, P. R. (2012). Assessment of pharmacognostic and phytochemical standards of Thespesia populnea (L.) root. Asian Pacific Journal of Tropical Biomedicine, 2(3), S1212-S1216
[13] Chlopicka, J., Pasko, P., Gorinstein, S., Jedryas, A., Zagrodzki, P. (2012). Total phenolic and total flavonoid content, antioxidant activity and sensory evaluation of pseudocereal breads. LWT- Food Science Technology, 46, 548-555
[14] Barry, A. L., Thornsbery, C., Lennette, J. P. (1981). In susceptibility testing; Diffusion tests procedures. In Manual of Clinical Microbiology; 3rd Edn, American Society for Microbiology: Washington, DC, e561
[15] Senthil-Rajan, Srinivasan, D., R., Rajkumar, Kumarappan, M., C., Arunkumar, K., Senthilkumar, K. L., & Srikanth, M. V. (2013). Investigation on antimicrobial activity of root extracts of Thespesia populnea new antibiotic resistant antimicrobial drugs to combact the antibiotic resistant strains. Linn. Tropical Biomedicine, 30(4), 570-578
[16] Hopkins, W. J., Uehling, D. T., Wargowski D. S., (1999). Evaluation of a Familial Predisposition to Recurrent Urinary Tract Infections in Women. American Journal of Medical Genetics, 83, 422–424
[17] Das, K., Tiwari, R. K. S., Shrivastava, D. K. (2010) Techniques for evaluation of medicinal plant products as antimicrobial agent: current methods and future trends. J Med Plant Res, 4(2), 104–111NIST/EPA/NIH Mass spectra library with search program (Data: NIST, software2` version 2.0), NIST standard reference database, 2002, no.76422



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY