IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, October 2024

Review on Spirulina and Health Benefit

Dalvi Saurav Ramchandra, Borude Sanket Ashok, Prof. Puranik Aboli K. ,Dr. Ingle Sanjay J.
Dharmraj Shaikshanaik Pratishthan College of Pharmacy, Ahilyanagar, Maharashtra, India

Abstract: *Undernutrition is a challenge for public health, especially in developing nations. Many years ago, it was proposed to employ algae, namely spirulina, as a functional food. This was because spirulina is a high-protein food source with an amino acid profile that is thought to have a high biologic-value protein content. Free-floating filamentous microalgae that thrive in alkaline water sources are known as spirulina. In Central Africa, spirulina has been eaten for millennia due to its high nutritional content. Today, it is a commonly utilized food supplement in the area of nutraceuticals. Its therapeutic advantages on a variety of sick situations, such as hypercholesterolemia, hyperglycerolemia, cardiovascular illnesses, inflammatory diseases, cancer, and viral infections, have recently attracted a lot of attention and significant research. The main causes of spirulina's cardiovascular health advantages are its hypolipidemic, antioxidant, and anti-inflammatory properties. Information from preclinical research using different animal models Continually show that spirulina has hypolipidemic properties.*

Keywords: Algae, Spirulina, Amino Acid, Protein, Microalgae, Fillament, Millennia, Hypolipidemic

I. INTRODUCTION

Blue-green algae supplement Spirulina is also a medication supplement. It's regarded as a superfood with a host ofpossible healthbenefits. Spirulina is the dried form of the oxygenic photosynthetic bacterium arthcospira platenetic, and it has a long history of use as food. It naturally occurs in central America and African Asia's alkaline lakes. Up until the sixteenth century, spirulina was a staple diet the Aztecs and other Mesoamerican people. The Aztecs gathered it from the lack Texcoco in Mexico, calling it "tecuitlatl." Pioneer Jean Leonard's work on Spirulina led to a significant scientific finding about the planet in the 1960s. He discovered these microalgae while on a trip to Chad and named it Spirulina platensis. The present study of this super algae began with this discovery. More recently, in the 1960s, French researchers discovered spirulina in abundance near Lack Texcoco. Spirulinahas been used as a supplement by NASA astronauts on space missions. Spirulina has a high protein, vitamin, essential amino acid, dietary mineral, iron, and fatty acid content, according to a chemical test.

SPIRULINA:

Microalgae, or single-celled photosynthetic organisms, are categorized as Spirulina and are members of the Cyanophyceae family. Scientifically speaking, it is referred to as Arthrospira platensis or **Spirulina platensis**.

DOI: 10.48175/IJARSCT-19970

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, October 2024

ORIGIN AND BACKGROUND:

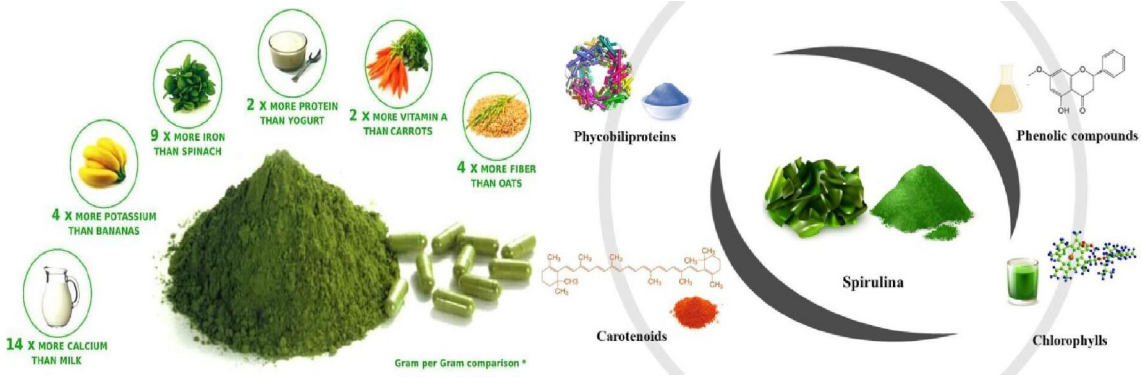
1. **Ancient origins:** Many societies, notably the Aztecs and Mayans of Central America, have been using spirulina for generations.
2. **Modern rediscovery:** The nutritional benefit of spirulina was proved by French scientist Jean Leonard in the 1960s.

FUTURES:

1. **Tiny dimensions**: 1-2 µm in diameter and 0.2-0.5 mm in length.
2. **Helical shape**: spiral structure that is coiled.
3. **Photosynthetic:** Uses sunshine to produce energy.
4. **High protein content**: 70 percent of the weight is protein.
5. Packed with nutrients, including antioxidants, vital fatty acids, iron, calcium, and vitamins B12, A, and E.

BENEFITS TO NUTRITIONS:

1. **Supplemental protein:** Perfect for vegetarians and vegans.
2. **Energy boost**: Iron-rich foods fight weariness.
3. **Immune system support**: Promotes the generation of antibodies.
4. **Antioxidant qualities**: Prevents oxidative damage.
5. **Cardiovascular health:** Reduces blood pressure and cholesterol.



USES IN THERAPY:

1. **Cancer treatment**: Stops the proliferation of cancer cells.
2. **Neuroprotection**: Could aid in the treatment of neurodegenerative illnesses.
3. **Antagonist**: Diminishes inflammation.
4. **Gut health**: Promotes the gut microbiota.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, October 2024

LITRACHURE SURVEY OF SPIRULINA:

Databases

1. 1,543 items in PubMed
2. 1,216 articles on Scopus
3. 934 items on the Web of Science
4. 2,300 papers on Google Scholar

Qualifications for Inclusion

1. The language of English
2. Research on people and animals
3. Date of publication: 2010–2024

MG for Exclusion

1. Language other than English
2. Research conducted either in vitro or in silico
3. Publication date: before to 2010
4. Articles without peer review

PIGMENT:

present in chlorophyll

spirulina Because green blood chlorophyll in spirulina resembles the haemoglobin molecule found in human blood cells; it is sometimes referred to as "green blood." One of the purifying and detoxifying substances, chlorophyll is known to promote peristaltic action, which in turn improves constipation.Carotene With 21 times the amount of beta-carotene as fresh carrots and 10 different carotenoids, of which nearly half are orange carotene, spirulinais the highest food source of beta-carotene. Phycocyanin a green pigment released in bile that is a source of biliverdin, a blue polypeptide. Porphyrin It is necessary for red blood cell production. As a chelator for the toxicity of heavy metals. Because the tetrapyrrole nucleus contains nitrogen atoms, porphyrins can bind divalent metal ions. Magnesium, the core ion in chlorophyll, is released from the compound in acidic environments so that other metals can bond in its stead.

Enzyme

Many different enzymes are found in spirulina. Superoxide dismutase (SOD), which is vital for scavenging free radicals and delaying the aging process, is among the most critical enzymes. Essential enzymes are also necessary for the body to absorb amino acids. The body cannot produce the 10,000+ long, complex sequences of amino acids called as proteins, which are the most powerful intracellular antioxidants and linked to stem cells and human pigment bilirubin. This is because SOD is not present in the body.

HEALTH BENEFITS

Food supplements are increasingly popular all over the world, including those based on microalgae. Most often, such products contain biomass of cyanobacteria belonging to the genera of Arthrosporic (which is sold as Spirulina,,) and are marketed for their potential, biological and nutritional value activity. Spirulina spa and its processing products are employed in agriculture, food industry, pharmaceutics, perfumery and medicine. For each application the basic description of disease, mechanism of damage, particular content of Spirulina spp. for treatment, in vivo and/or in vitro usage, factors associated with therapeutic role, problems encountered and advantages are given. In addition, It has antiseptic qualities as it reduces swelling and promotes granulation- a process that regenerates new tissue over injuries

SPIRULINA IS A PERFECT FOOD FOR ANTI-AGING:

high antioxidant content, easily absorbed, and concentrated vitamin value. For healthy eyes and vision, beta carotene is beneficial. While iron is the most commonly occurring mineral deficit, it is necessary to construct a robust system.

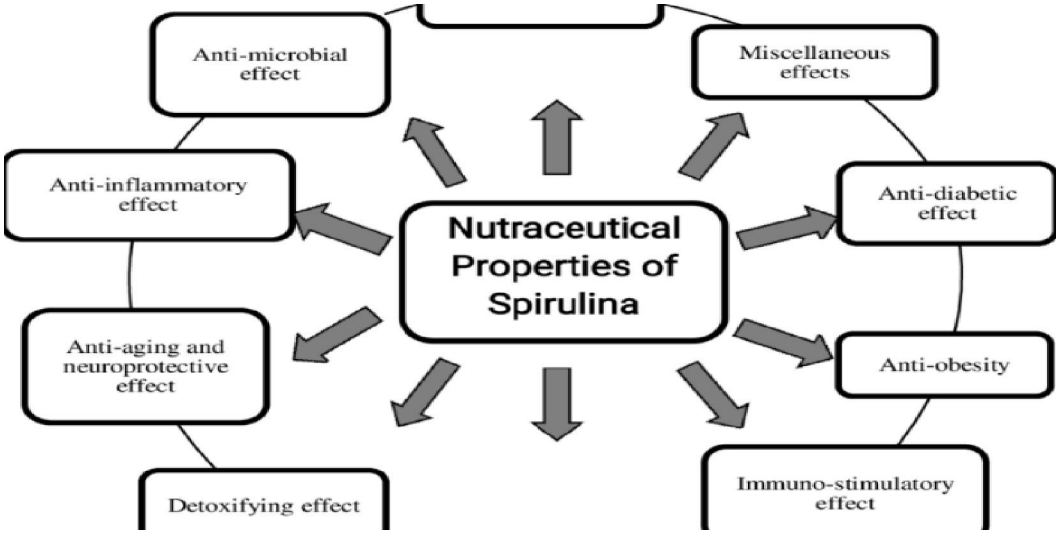
IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, October 2024

Spirulina is easier to absorb than iron supplements and is rich in iron, magnesium, and trace elements. It has the highest concentration of B-12, which is vital for vegetarians in particular to maintain healthy nerves and tissue.

BENEFICIAL TO SKIN:

Consume carrots, sprouts, oats, oranges, lemons, pumpkin, parsley, purified water, and herbal teas every day, in addition to a healthy dose of spirulina. One of the best anti-aging ingredients is spirulina. Beta-carotene also helps prevent sunburn and slows down the aging process of the skin caused by UV radiation. Another potent source of the antioxidant that promotes skin oxygenation is spirulina. Gamma linolenic acid (GLA), a polyunsaturated fatty acid that gives skin suppleness, is abundant in spirulina.

NEUTRACEUTICAL PROPERTIES OF SPIRULLINA:



The collected spirulina are processed in the following ways:

The spirulina that is collected is screened and checked for pond debris, and microscopic algae that give thickened spirulina finally, the water obtained is recycled to the pond. The spirulina droplets are spray-dried and vacuumed into a hopper in the packaging room for collection, which preserves nutrients, pigments, and enzymes that are sensitive to heat (phycocyanin content). Spirulina powder is compressed directly into tablets and sealed in both glass and plastic bottles

SPIRULINA AS A WOUNDERFUL FUTURE FOOD SOURCE:

Spirulina has the wonderful ability to be used in preparing concentrated food of high quality. Nowadays Spirulina is a perfect food and nutritional supplement for the 21st century by the Food and Agriculture Organization (FAO) of the United Nations. The verification of food ingredients is of critical concern to food processors since the purity of food ingredients is certainly a subject to exploitation by unscrupulous suppliers (Rosario & Josephine, 2015). Spirulina has been used as a complementary dietary ingredient of feed for fish, shrimp and poultry, and progressively as a protein and vitamin complement to aqua feeds. China is consuming of microalgae as a partial substitute of imported forage to motivate the growth, immunity and viability of shrimp. There has also been inclusive research on the use of Spirulina as aquaculture feed additives in Japan (Santos et al., 2016). Spirulina contains several nutrients and vitamins. It has all the essential amino acids, Beta carotene, Gamma linolenic acid, Vitamin B, trace elements, etc. It has 180% more calcium than milk, 5100% more iron than spinach, 670% more protein than Tofu and 3100% more beta carotene than carrots. Three grams of Spirulina displays high antioxidant and anti-inflammatory activity than five more fruits and vegetables. In phytonutrients spirulina is 60 times better than spinach, 31 times better than blue berries and 700 times

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, October 2024

ANTIOXIDANT, IMMUNOMODULATORY AND ANTIINFLAMMATORY ACTIVITY OF SPIRULLINA:

Spirulina is a species of filamentous cyanobacteria that has long been used as a food supplement. In particular, Spirulina platensis and Spirulina maxima are the most important. Thanks to a high protein and vitamin content, Spirulina is used as a nutraceutical food supplement, although its other potential health benefits have attracted much attention. Oxidative stress and dysfunctional immunity cause many diseases in humans, including atherosclerosis, cardiac hypertrophy, heart failure, and hypertension. Thus, the antioxidant, immunomodulatory, and anti-inflammatory activities of these microalgae may play an important role in human health. Here, we discuss the antioxidant, immunomodulatory, and anti-inflammatory activities of Spirulina in both animals and humans, along with the underlying mechanisms. In addition, its commercial and regulatory status in different countries is discussed as well. Spirulina activates cellular antioxidant enzymes, inhibits lipid peroxidation and DNA damage, scavenges free radicals, and increases the activity of superoxide dismutase and catalase. Notably, there appears to be a threshold level above which Spirulina will taper off the antioxidant activity. Clinical trials show that Spirulina prevents skeletal muscle damage under conditions of exercise-induced oxidative stress and can stimulate the production of antibodies and up- or downregulate the expression of cytokine-encoding genes to induce immunomodulatory and anti-inflammatory responses. The molecular mechanism by which Spirulina induces these activities is unclear, but phycocyanin and β-carotene are important molecules. Moreover, Spirulina effectively regulate

ANTIOXIDANT PROPERTIES OF SPIRULINA ASH:

Spirulina is free-floating filamentous microalgae growing in alkaline water bodies. As early as over 400 years ago, Spirulina was eaten as food by the Mayas, Toltec's and Kanembu in Mexico during the Aztec civilization. Spirulina is a well-known source of valuable food supplements, such as proteins, vitamins, amino acids, minerals, fatty acids, etc. It is widely used in human and animal nutrition, as well as in the cosmetic industry. Both in vivo and in vitro trials have shown effective and promising results in the treatment of certain cancers and allergies, anaemia, hepatotoxicity, viral infection, vascular diseases, radiation protection, and obesity. The antioxidant activities of Spirulina were demonstrated in a large number of preclinical studies. Antioxidants in preventing many human diseases. Findings of this study showed Spirulina can be used as a source of antioxidants

ANTIVIRAL AND ANTIMICROBIALACTIVITES OF SPIRULINA:

It is interesting that microalgae and cyanobacteria, such as spirulina, that we associate with food emerge with high antimicrobial activity and contain important antimicrobial molecules Spirulina has a variety of pharmacological properties, including antimicrobial (including antiviral and antibacterial), anticancer, antimicrobial, anti-inflammatory, hypocholesterolemic, radio protective, and metalloprotective (prevention of heavy-metal poisoning Antimicrobial activity has been demonstrated in vitro for several herb and spice extracts and essential oils from thyme, oregano, parsley, cilantro, and cinnamon. Growth of several bacteria strains has been shown to be inhibited by various concentrations of these culinary herb and spice extracts in the culture medium. Information about Nutrition for Spirulina Spirulina, one tablespoon, contains: 20 calories 4 grams of protein One gram of fat Two grams of carbs grams of fibre Zero grams of sugar A good source of: is spirulina. Vitamin B1, or thiamine Vitamin B2, riboflavin Vitamin B3 or niacinIron Copper There is also magnesium in spirulina. This mineral helps your heartbeat and other regular everyday processes like muscle contractions. In addition, it produces energy and protein, but most people don't get enough of it in their diets.

SPIRULINA PROTEIN:

Spirulina is rich in plant protein. Protein makes up 65% to 70% of its content. Most of this protein comes from phycocyanin, a pigment that gives spirulina its blue-green colour. Potential Health Benefits of Spirulina Spirulina is a rich source of vitamins, minerals, and fatty acids. It's also high in the plant protein phycocyanin, which has antioxidant and anti-inflammatory properties. These nutrients in spirulina are linked to several health benefits: Anti-cancer properties Many antioxidants in spirulina have anti-inflammatory effects in the body. Chronic inflammation contributes to cancer and other diseases. Phycocyanin has been found to not only reduce inflammation in the body, but also block tumour growth and kill cancer cells. The immune-enhancing protein is being studied for its potential in cancer

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, October 2024

treatment. heart wellness Studies have shown that the protein in spirulina helps lower cholesterol levels by preventing your body from absorbing cholesterol. This keeps your arteries free of blockages, which lessens the strain on your heart and lowers the risk of blood clots that can cause stroke and heart disease. Additionally, phycocyanin lowers lipid levels. These blood fats raise your chance of developing pancreatitis, diabetes, and heart disease by hardening your arteries. Additionally, nitric oxide generation is increased by spirulina, which facilitates the relaxation of blood vessels. According to studies, doing this can drop your blood pressure and lower your risk of heart disease. Relief from allergies You may benefit from the anti-inflammatory properties of spirulina's antioxidants if you suffer from allergies to dust, pollen, or animal fur. According to one study, spirulina considerably reduced symptoms like congestion, sneezing, and itching, indicating that it might be a useful substitute for allergy medicines. immune system assistance Vitamins E, C, and B6 are among the many vitamins and minerals found in spirulina that are vital for a strong immune system. According to research, spirulina also increases the body's ability to produce white blood cells and antibodies, which are used to combat bacteria and viruses. Spirulina has been shown in lab tests to combat HIV, herpes, and the flu; however, human trials are still a long way off. oral and eye health Zeaxanthin, a plant pigment that may lower the risk of cataracts and age-related vision loss, is concentrated in spirulina. Its antimicrobial qualities might also support dental health. One study discovered that individuals' dental plaque and gingivitis risk were decreased by spirulina-enhanced mouthwash. It reduced the risk of mouth cancer in tobacco chewers, according to another study. Loss of weight Protein from spirulina takes longer for your body to process and can help you avoid hunger. According to one study on low-calorie diets, participants who took a spirulina supplement lost more weight and body fat than those who took a placebo.

SPIRULINA USED BY ASTRONAUTS:

The blue-green algae known as spirulina, or Arthrosporic, sprang to fame when NASA successfully utilized it as a nutritional supplement for astronauts on space missions. It has the capacity to regulate immunological responses and demonstrates anti-inflammatory qualities by preventing mast cells from releasing histamine. Spirulina and chlorella algae are used as food sources. This is so because Spirulina and Chlorella are SCPs, or single-celled proteins. When in orbit, space explorers use capsules containing spirulina as a food source. Because it releases oxygen, chlorella is referred to as the "space algae."

USES FOR THERAPY:

1. **Cancer treatment**: Examine the anticancer properties of spirulina and its function in preventing cancer.
2. **Neuroprotection:** Examine the potential for managing neurodegenerative diseases as well as the neuroprotective benefits of spirulina.
3. **Cardiovascular health:** Research the effects of Spirulina on illness prevention and cardiovascular risk factors.
4. **Immunomodulation**: Look into the benefits of spirulina on the immune system and its ability to modulate it.

STUDIES ON TOXICITY AND SAFETY:

1. Safety profile of Spirulina, National Institutes of Health (NIH).
2. The safety evaluation of Spirulina platensis by the European Food Safety Authority (EFSA).
3. Kumar et al. (2020): Toxin assessment of spirulina.

II. CONCLUSION

Rich in nutrients, spirulina is a microalgae that has several health advantages. Its nutritional worth, medicinal potential, and environmentally friendly manufacture make it a desirable supplement for a range of uses.

FUTURE PATH

1. **Individualized nutrition:** Examine the possibilities of spirulina in terms of wellbeing and individualized nutrition.
2. **Symbiotic:** Examine how spirulina works in concert with other bioactive substances.
3. **Environmental sustainability**: Evaluate the effects of spirulina cultivation on the environment.

IJARSCT
ISSN (Online) 2581-9429
International Journal of Advanced Research in Science, Communication and Technology (IJARSCT)
International Open-Access, Double-Blind, Peer-Reviewed, Refereed, Multidisciplinary Online Journal
Impact Factor: 7.53
Volume 4, Issue 3, October 2024

REFERENCES

[1]. Chatterjee et al. (2019). Spirulina platensis: A review of its immunomodulatory, anticancer and antioxidant properties. Journal of Ethnopharmacology, 231, 145-155.
[2]. European Food Safety Authority (EFSA). Spirulina platensis.
[3]. Food and Agriculture Organization (FAO) of the United Nations. Spirulina.
[4]. Gershwin et al. (2017). Spirulina in Human Nutrition and Health. Academic Press.
[5]. Habib et al. (2017). Spirulina: Production, Processing and Applications. CRC Press.
[6]. https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcQXU3NiSv0xF84DvrcwiExzY0N1NMR8DCMuQ&s
[7]. https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcRbkhlBIx7c7a3jJFgSy3v60O3fA2lHds7UQQ&s
[8]. https://plantinstructions.com/wp-content/uploads/2022/08/how-to-grow-spirulina-950x640.jpg
[9]. https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.researchgate.net%2Ffigure%2FDiverging-radial-representations-corresponding-to-the-health-benefits-of-Spirulina_fig1_370650621&psig=AOvVaw0zs236pQgqviGgMni1F3vK&ust=1729329325127000&source=images&cd=vfe&opi=89978449&ved=0CBQQjRxqFwoTCPiY1fTLl4kDFQAAAAAdAAAAABAE
[10]. https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.spirulinanb.com%2F10-health-benefits-of-spirulina-evidence-based-human-applications%2F&psig=AOvVaw1csFoMMP-DSPPY48vo3Fbx&ust=1729435082579000&source=images&cd=vfe&opi=89978449&ved=0CBQQjRxqFwoTCJjxlPTVmokDFQAAAAAdAAAAABBB
[11]. Khan et al. (2018). Spirulina supplementation improves immune function in HIV patients. Journal of Medicinal Food, 21(10), 1039-1046.
[12]. Kumar et al. (2018). Spirulina: A nutraceutical with immunomodulatory and anticancer properties. Journal of Food Science and Technology, 55(4), 1165-1174.
[13]. Mohd et al. (2020). Spirulina: A review on its nutritional, pharmacological and biomedical applications. Journal of Pharmacy and Pharmacology, 72(8), 1031-1044.
[14]. National Institutes of Health (NIH). Spirulina.
[15]. Singh et al. (2020). Spirulina platensis: A review on its nutritional, pharmacological and biomedical applications. Journal of Pharmaceutical and Biomedical Sciences, 10(2), 1-12.
[16]. Singh et al. (2020). Spirulina platensis: A review on its nutritional, pharmacological and biomedical applications. Journal of Pharmaceutical and Biomedical Sciences, 10(2), 1–12.