A Comprehensive Review of Herbalism

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By

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Dedicated to

All the patients who passed away from severe diseases

"Herbalism is based on relationships-
Relationship between plants and humans,
Plant and planet, human and planet.

Using herbs in the healing process means
taking part in an ecological cycle."

By Wendell Berry

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ABSTRACT

Natural products play an essential role in the battle against cancer and serve as a useful entry point for the development and testing of new therapeutic agents. As a result, there is an urgent need for more effective drugs to combat this disease. Natural products play an essential role in the battle against cancer and serve as a useful entry point for the development and testing of new therapeutic agents. The discovery and development of various drugs can be aided by medicinal plants. Medicinal plants contain a variety of physiologically active chemicals that help them treat different health issues. Alkaloids, flavonoids, phenolics, carotenoids, and other secondary metabolites are found in them. The advantages of plant-based therapy over synthetic (chemical) treatment have elevated the importance of medicinal plants in the healthcare profession. Various pharmacological properties have been discovered in a variety of medicinal plants.

Natural products have been a rich source of compounds in antibiotic drug discovery with most antibiotic drugs being derived from a natural product or natural product lead. However, the rapid onset of resistance to most antibiotics diminishes their effectiveness considerably in the last two decades. More reason to add to the current crisis in antibiotic development is the poor return on investment, which is substantial in drug development. Despite this, smaller pharmaceutical companies are attempting to address the medical need for new antibiotics. In addition, the structural complexity of many natural products has often been understood as an obstacle, since it may impose serious challenges to chemical synthesis and derivatization during the lead optimization process. There is an urgent necessitates for a constant supply of new antibiotics for the effective treatment of infections.

Therefore, the present work investigates the effect of different medicinal plants on different activities. This book is compiled in three parts. Each part includes different chapters.

The first part of this book is compiled into five chapters. The first chapter of Part I, “Introduction” defines the role of medical plants in the treatment of cancer. The multiple and important pharmacological properties of the *Aloe barbadensis, Ocimum sanctum, Triticum aestivum, Tinospora cordifolia, and Azadirachta indica* and their scientific evidence are trying mentioned in brief.

The second chapter of Part I, “Preparation of CSCE[a] and CSIC[b] for skin carcinoma potential” describes the preparation of herbs samples i.e. Combine samples of crude extracts and Combine samples of isolated compounds. The anticancer activity of the combined sample of crude extracts was also evaluated and judged against the combined sample of isolated compounds. The results are gathered in the same chapter.

The third chapter of Part I, “Screening of antimicrobial activity" describes the investigation of the antimicrobial activity of crude extracts of *A. barbadensis, O. sanctum, T. aestivum, T. cordifolia, A. indica,* combine sample of crude extracts and combine sample of isolated compounds. The results are compiled in the same chapter.

In the fourth chapter of Part I, "Discussion and Conclusion," an attempt is made to reconcile the findings of the current study with those of previous studies. The fifth chapter of Part I, "Future scope," indicates that many herb samples had good antioxidant and antibacterial action, as well as some protection increased against skin cancer by preventing papilloma formation due to the synergistic effect. Also, submit some new research ideas and advancements for the future.

The second part of this book is compiled into nine chapters The first chapter of Part II provides an "Introductory note" on natural products, their usage in Ayurveda, a description of phytomedicine, phytochemicals, secondary metabolites, and their classification, the role of ROS and free radicals in diseases. A detailed account of antioxidants and natural antimicrobial agents has been discussed. The role of antioxidants in hemoglobin hike and immune-boosting properties have been enumerated. An account of Silico practice has also been described which includes the identification and validation of a target using Molecular docking.xii

The second chapter of Part II accounts for the "taxonomic classification of the selected plants". The chapter also accounts for the introduction of the plants and their therapeutic significance as identified and discussed in the related literature published so far.

The third chapter of Part II compiles "the collection and authentication of the plant parts, their physical examination, and methods of extraction".

The fourth chapter of Part II provides a detailed account of "the phytochemical analysis" of the crude extracts using infrared (IR) identification and Thin Layer Chromatographic (TLC). The results of each analytical test have been discussed and compiled for each plant extract.

The fifth chapter of Part II describes “the investigation of antioxidant activity evaluation” of crude extract using NO scavenging activity, DPPH assay, and total antioxidant activity. Results have been compiled in the same chapter.

The sixth chapter of Part II describes "the investigations related to antimicrobial activity evaluation" of crude extract using the disk diffusion method. Corresponding results and figures are included in the same chapter.

The seventh chapter of Part II accounts for "the estimation of antioxidant and antimicrobial activity of plant extract combinations". Various combinations are made and tested for their antioxidant activity using total antioxidant activity and disk diffusion method. The results and graphical comparisons have been produced in this chapter.

The eighth chapter of Part II provides "the investigations related to computational studies towards target identification and validation for the antioxidant and anti-inflammatory activity of selective phytochemicals". An inclusive library of phytochemicals from selected plant extracts has been designed using the IMPPAT database. Selective biological targets (proteins) responsible for antioxidant and anti-inflammatory activities were screened using the present library of phytochemicals using molecular docking. The chapter results include a list of identified phytochemicals that may be responsible for antioxidant and anti-inflammatory activity.

The ninth chapter of Part II provides a "conclusion of all chapters, the future scope, and further recommendations based on the outcomes of present work".

The third part of this book is compiled into seven chapters. The first chapter of Part III, "Introduction" defines the importance of a new compound that is isolated from medicinal plants. The second chapter of part III represents the chemical investigation and isolation of a new compound from *Echinops-echinatus* (roots). The third chapter of part III discussed the Chemical Investigation and Isolation of Novel compounds from the outer seed coat of *Butea-mono sperma.* The fourth chapter of this part includes the: Chemical Investigation and Isolation of a novel compound from the flower of *Mimosa rubicaulis. The fifth and sixth chapters of this part explained* screening of Antifertility activity and hormonal biography of *Musa para di sica* & *Echinops-echinatus.* The last chapter of part III involved the Screening of the Antimicrobial Activity of Plant Extracts.

PART I

SYNERGISTIC EFFECT OF HERBS AGAINST ANTICANCER AND ANTIMICROBIAL PROPERTIES

CHAPTER ONE

INTRODUCTION

1.1 Role of Natural Products as a Medicine

Natural products have played a significant part in the treatment of human illnesses throughout history. Salicylates and willow, as well as quinine and cinchona, are well-known examples; similarly, the fabled discovery of penicillin changed the world. Furthermore, traditional treatments, which are mostly based on terrestrial plants, continue to dominate therapeutic practices around the world, and natural products make up a significant fraction of today's pharmacological agents, particularly in the areas of antibiotics and cancer therapies [1]. Early detection and definitive tumor eradication through radiation therapy or surgical resection offer the best chances for cancer treatment. Chemotherapy, on the other hand, is usually required when dealing with malignant, metastatic disease. Many of the significant advancements in cancer treatment have been closely associated with the discovery of natural product medications [2].

Regardless of these advancements, cancer continues to be the biggest cause of death worldwide. For example, 589,430 fatalities and 1,658,370 new cancer cases were expected in the United States in 2015 [3]. Given the disease's high morbidity and mortality rates, as well as the considerable economic impact, more effective methods are still urgently needed. Without a question, preventing human cancer is superior to treating it. In this regard, the introduction of vaccines to prevent hepatitis and, as a result, liver cancer is perhaps the most significant achievement, while the more recent development of vaccines to prevent cervical cancer has promise. Another key method for relieving this massive public health burden is cancer chemoprevention, which involves using synthetic or natural chemicals to hinder, delay, or reverse the process of carcinogenesis [4].

In a perfect world, cancer chemoprevention would be as effective as vaccinations in preventing human diseases. Although proof of principle has yet to be demonstrated, crucial clinical trials for the prevention of breast cancer with tamoxifen, and more recently with tamoxifen cousins such as raloxifene, and a separate class of aromatase inhibitors, have established

proof of principle. Finasteride, for example, has shown promise in the prevention of prostate cancer [5]. Natural products have played a critical part in cancer chemoprevention studies, especially when it comes to medications under investigation, such as cancer chemotherapeutic agents.

Over 60% of today's anticancer drugs are derived from natural sources in one way or another [6]. While few isolated natural products are developed into clinically effective drugs in their own right, these unique molecules frequently serve as models for the preparation of more efficacious analogs and prodrugs using chemical methodologies such as total or combinatorial (parallel) synthesis or manipulation of biosynthetic pathways. Furthermore, advances in formulation could lead to more effective medication administration to patients, or coupling of harmful natural compounds to monoclonal antibodies or polymeric carriers that target epitopes on tumors of interest could lead to the creation of successful targeted therapies [7]. Natural products play a critical role in the discovery and development of novel anticancer drugs, and multidisciplinary collaboration is critical in the optimization of novel molecular leads derived from natural product sources [8].

Selectively targeting epitopes on cancers of interest can facilitate the development of successful targeted therapies. The following sections briefly review some of the most recent discoveries in this field, focusing on novel drugs that are now in advanced clinical research or have been approved for commercial use. It's worth noting that effective cancer chemotherapy frequently entails the use of multiple drugs in combination (so-called combination chemotherapy), and these combination regimens can include both natural and synthetic agents [9].

Synergism plays a key role in the therapeutic efficacy of herbal medicine and its formulation. It is presumed to occur if the active concentration of ingredients in the combination is considerably reduced or the effects of ingredients in combination are considerably increased concerning that of each distinct ingredient. This cannot be easily well-known from additive effects and commonly rely on high limits of deviation. The mechanism of action of various herbal medicines is still unidentified and there are several examples of a total herb extract screening with an enhanced effect than the same dose of an isolated compound. It will possibly implicate a comprehensively new line, for instance by examining mechanisms using new molecular biology methods for the isolated ingredients individually and in combination, which is already described by Wagner. In this admiration, we are only at the creation of a remarkable novel study, which must shed light on how exactly these therapies' efforts and finally consequences in condensed side effects and an improved therapeutic accomplishment.

Overall, synergistic effects are measured to be constructive, with the low doses used supposed as a value, even though it is noticeable that there may also be undesirable features.

The advance to repress the progression of carcinogens by the herbally occurring agent is promising because this approach has been valuable against the high incidence of low survival rate of most cancers. In this regard, naturally occurring compounds such as alkaloids, flavones, retinoids, antioxidants, etc. inspired by persons are getting more and more awareness. The drug obtained from different medicinal herbs is used to prove several pharmacological applications. In recent times, scientists intended to determine new drugs from higher plants that lead to the improvement of drugs like reserpine, which is isolated from *Rauwolfia serpentine* used for the medication of hypertension and various other medical problem like insomnia. Vinblastine and vincristine, obtained from *Catharanthus roseus* by using different isolation methods have been used for the prevention of various diseases like cancer. After, these isolated drugs were found to be alkaloids from their structure. So isolation, purification, and structural elucidation of the active chemical constituent will give much stress on the biological significance of medicinal plants. Alkaloids and many other chemical compounds such as flavonoids, tannins, saponins, phytosterols, etc isolated from different medicinal plants are used for the treatment of various diseases like cancer and many more.

In traditional medication methods, combinations of plants are practiced instead of single species and so the condition is even further difficult, even though very similar perceptions of synergy relate, that is a blend of the dual or more species contributes an improved result than either species on its individual. 'Triphala' is a distinguished polyherbal preparation (Churna) in ISM mainly in Ayurveda meanwhile early period, used for various therapeutic resolutions. This preparation was organized as powdered preparation, in the permutation of parched fruits of *Terminalia bellirica, Emblica officinalis,* and *Terminalia chebula*, in the same ratio as defined in the Ayurvedic Formulary of India (AFI). Traditionally, this formulation has been given as first-line prevention for various diseases such as a laxative in the detoxifying agent of the colon, food digestive problems, chronic constipation, rejuvenator of the body, etc. The above-mentioned three fruits were varied based on their rich polyphenol portion present therein and combined as a formulation which is the established example of a synergistic combination.

The plant kingdom is a virtual goldmine of a new chemical compound having different medicinal properties. This part involves the combination of

crude extracts and the combination of their isolated compounds of the following medicinal plants.

1.2 Introduction to the Family of *Aloe Barbadensis*

Order: Asparagales
Family: Asphodelaceae
Genus: *Aloe*
Species: *A. barbadensis*

Aloe vera is a perennial, drought-resisting, succulent plant belonging to the *Asphodelaceae* family. It is sometimes described as a wonder plant and historically has been used for a variety of medicinal purposes. It has a vast traditional role in indigenous systems of medicine like Ayurveda, Siddha, Unani, and Homoeopathy [10]. Clinical evaluations have revealed that the pharmacologically active ingredients are concentrated in both the gel and rind of the Aloe vera leaves. The plant contains flavonoids, terpenoids, mono and polysaccharides, tannins, vitamins, minerals, enzymes, sugars, anthraquinones, salicylic acid, sterol, and amino acids. Active ingredients show various pharmacological properties [11, 12].

1.3 Scientific Basis of Some of the Medicinal Properties of *Aloe Barbadensis*

Immunomodulatory activity: Madan *et al.* evaluated the immunomodulatory property of Aloe vera extract. Administration of extract in mice for 5 days significantly increases total white blood cell count and macrophages with the engulfed Sleep Red Blood Cell mice. This showed that Aloe vera extract possesses immunomodulatory activity [13].

Antidiabetic activity: Bahram *et al.*'s objective was to study the effect of *Aloe barbadensis* leaf extract on oxidative stress of hepatic tissue in streptozotocin-induced diabetic rats. The enzymatic activities were measured as indicators of antioxidation in liver tissue. Wistar rats were made diabetic with a single injection of streptozotocin. Diabetic rats were treated with Aloe vera extract for 8 weeks. The results obtained, showed that Aloe vera extract alleviates oxidative stress of hepatic tissue in streptozotocin-induced diabetic rats [14].

Agarwal, Yongchaiyudha, *et al.*, and Bunyapraphatsara *et al.* reported the hypoglycemic and hypolipidemic effects of an Aloe vera gel in combination with different antidiabetic drugs [15-17].

Antimicrobial activity: Pandey *et al.* tested the antibacterial activity of *Aloe barbadensis* on clinically isolated bacterial pathogens, causing

infection in human beings. The results of this study give credence to the antibacterial use of *A. barbadensis* gel and leaf [18].

Agarry *et al.* demonstrated a comparative study on the antimicrobial activity of the gel and leaf of Aloe vera against different microorganisms. Antimicrobial susceptibility tests showed that both the gel and the leaf inhibited the growth of microorganisms [19].

Antioxidant activity: Hu *et al.* determined the antioxidant activity of Aloe vera extract by using the DPPH radical scavenging method. The different aloe extracts showed significant antioxidant activity [20]. Mazzulla *et al.* also demonstrate that Aloe vera extract inhibits the generation of DPPH and the scavenging activity was increased in a dose-dependent manner.

Nwanjo *et al.* also show that the Aloe vera leaves extract possessed strong antioxidant activity [21].

Anticancer activity: Ahirwal *et al.* evaluated the *in vitro* antitumor activity of Aloe vera extract in cultured B16F10 melanoma cell line by measuring cell viability using the Trypan blue exclusion assay method. Evaluation of *in vitro* antitumor activity revealed that Aloe vera extract exhibits good cytotoxic activity [22].

Chandu *et al.* evaluated the antitumor activity of Aloe vera extract in melanoma cell lines by measuring cell viability and the results revealed that the Aloe vera extract shows good cytotoxic activity [23].

El-Shemy *et al.* evaluated the anticancer potential of active principles of Aloe vera. *In vivo*, active principles exhibited significant inhibition on Ehrlich ascites carcinoma cells [24].

Wound healing activity: Davis *et al.* studied the effect of Aloe vera orally and tropically. Wounds were induced on both sides of the vertebral column of mice using a biopsy punch. Reduction in wound diameter was noted in mice those receiving an oral and topical application of Aloe vera. These facts suggest that Aloe vera is effective in wound contraction and accelerates healing [25].

1.4 Introduction to the Family of *Ocimum Sanctum*

Order: Lamiales
Family: Lamiaceae
Genus: *Ocimum*
Species: *O. sanctum*

Tulsi is an important symbol of the Hindu religious tradition and is also known by the names "the queen of herb", "the incomparable one" and "the mother medicine of nature". It has made an important contribution to the

field of science from ancient times as also to modern research due to its large number of medicinal properties. Tulsi is a popular home remedy for many ailments. The leaves of *Ocimum sanctum* contain 0.7% volatile oil comprising about 71% eugenol and 20% methyl eugenol. Fresh leaves and stems of *Ocimum sanctum* extract yielded some phenolic compounds (antioxidants). It also contains several sesquiterpenes and monoterpenes [26, 27].

1.5 Scientific Basis of Some of the Medicinal Properties of *Ocimum Sanctum*

Immunomodulatory effect: Tulsi is considered a sacred herb and traditionally it is believed that consumption of the Tulsi leaf on an empty stomach increases immunity. An experimental study by Mondal *et al.* has shown that an alcoholic extract of Tulsi modulates immunity [28].

Antidiabetic effect: Somasundaram *et al.* studied to find out the antidiabetic effect of *Ocimum sanctum* in type 2 diabetes patients as several studies have shown its antidiabetic effect experimentally, but very few studies are performed to examine the efficacy in humans. The study was performed in two different groups for 90 days. One group received Glibenclamide and another one received Glibenclamide with *Ocimum sanctum*. From the result of the study, he concluded that *Ocimum sanctum* can be used as an adjuvant in Type 2 Diabetes Mellitus patients [29].

Antimicrobial activity: Sadul Rama *et al.* showed that the alcoholic extract of *Ocimum sanctum* showed inhibition against different micro-organisms which proves that it has shown an effective antimicrobial activity. They act as a disinfectant [30].

Varshney explored the *in vitro* antibacterial effects of four different leaf extracts including *Ocimum sanctum*. His finding concludes that the leaves have antibacterial activity against *S. enteric, E. typhimurium*, and *E. coli* [31].

Antioxidant activity: Samson *et al.* analyzed the *in vivo* as well as the *in vitro* antioxidant activity of *Ocimum sanctum* in noise exposure. This experiment indicates that *Ocimum sanctum* has the potential for more evaluation as an ideal antioxidant for noise-induced oxidative stress [32].

Kath *et al.* investigated the antioxidant activity of leaf extract of *Ocimum sanctum* in animal models of peptic ulcer and explored a possible correlation between its antioxidant and antiulcer activities. Extract administration increased the levels of SOD signifying its antioxidant and antiulcer activity [33].

***Anticancer activity*:** Islam *et al.* designed a study to investigate the anti-neoplastic effect of the leaves of *Ocimum sanctum* against Ehrlich Ascites Carcinoma (EAC) in mice at different doses. Hematological studies reveal a significant decrease in RBC count and an increase in WBC counts in the extract of leaves of *Ocimum sanctum* treated animals [34].

Magesh *et al.* also used *Ocimum sanctum* extensively for its antitumor activity against human non-small cell lung carcinoma (NSCLC) A549 cells. The results of this study demonstrate that extract induces apoptosis in A549 cells via a mitochondria caspase-dependent pathway and inhibits the *in vivo* growth of lewis lung carcinoma, suggesting that extract of *Ocimum sanctum* can be applied to lung carcinoma as a chemopreventive candidate [35].

Several studies including Karthikeyan *et al.* proved that *Ocimum sanctum* plant extract has been shown to protect against chemically induced oral cancer and the development of skin papillomas in rodents [36].

Antifertility activity: Sethi *et al.* used the fresh leaves of *Ocimum sanctum* to study its effect on male reproductive function in male albino rabbits. 2 gram of leaves of *Ocimum sanctum* was administered to each rabbit for 30 days. A significant decline was noted in the sperm count. The result implies the potential use of *Ocimum sanctum* as an effective male contraceptive agent [37].

Seth *et al.* also showed a decrease in total sperm count, sperm motility, and weight of the testis by long-term feeding, approximately 3 months of *Ocimum sanctum* leaves to adult male and female albino rats together with a normal diet [38].

1.6 Introduction to the Family of *Triticum Aestivum*

Order: Cyperales
Family: Poaceae
Genus: *Triticum*
Species: *T. aestivum*

Wheat is the most important stable food crop for more than one-third of the world's population and contributes more calories and proteins to the world's diet than any other cereal crop. It is nutritious, easy to store and transport, and can be processed into various types of food [39]. Wheatgrass juice is inhaled as "Green blood" which is consumed to improve the hemoglobin concentration of blood as it contains mostly chlorophyll (about 70%). Wheatgrass is an excellent health-building food and is also called superb food [40, 41]. It contains 78.10% carbohydrates, 14.70% protein, 2.10% fat, 2.10% minerals, and considerable proportions of vitamins.

Wheat is also a good source of trace minerals like selenium and magnesium, nutrients essential to good health [42, 43, 44].

1.7 Scientific Basis of Some of the Medicinal Properties of *Triticum Aestivum*

Immunomodulatory activity: The study of Hemalatha *et al.* investigated the immunomodulatory activity of *Triticum aestivum* water extract in Swiss albino mice. Animals were challenged with Sleep Red Blood Cells and treated with *Triticum aestivum* and hematological, serological, and bone marrow cellularity evaluation was performed by collecting blood from the retro-orbital plexus. The finding confirms that the extract has a significant role in immunity [45].

Limbasiya *et al.* also studied the immunomodulatory effect of the hydroalcoholic extract of *Triticum aestivum* in different animal models by using a neutrophil adhesion test. From the results of the Limbasiya study, it was also concluded that the extract of wheatgrass has a significant effect on the immune system [46].

***Antidiabetic activity*:** Kothari *et al.* studied the antidiabetic activity of wheatgrass in normal rats. Administration of different doses of *Triticum aestivum* grass juice significantly reduced the total cholesterol, triglycerides, and low-density lipoprotein-cholesterol and shows that it possesses antidiabetic activity [47].

Antimicrobial activity: Das *et al.* were experimentally find out the antimicrobial activity of water extract of wheatgrass on gram-positive, gram-negative, and fungus. It was found that extracts of *Triticum aestivum* were active against the entire microorganism [48].

Jeong *et al*., Borchardt *et al.*, and Somani *et al.* evaluated the effectiveness of different extracts of *Triticum aestivum* for antibacterial activity against different bacterial strains by using paper-disc agar diffusion, disc diffusion, and kirby-bauer method respectively. The finding of these studies proves that the plant possesses good antimicrobial activity [49, 50, 51].

Antioxidant activity: Shukla *et al.* evaluated the antioxidant activity of aqueous and alcoholic extract of wheatgrass *in vitro* [52]. This study shows that *Triticum aestivum* possesses antioxidant activity.

Aydos *et al.* also evaluated the antioxidant activity of the same solvent extract by measuring different parameters such as catalase and SOD in chronic myeloid leukemia cell lines [53]. Kulkarni *et al.* also estimated the antioxidant activity of wheatgrass by employing different models and these models showed that *Triticum aestivum* possesses antioxidant activity [54].

Anticancer activity: Patel analyzed the anticancer property of *Triticum aestivum* on HeLa cells *in vitro* by using an MTT assay [55]. Tirgar *et al.* also evaluated the anticancer activity of isolated compounds of *Triticum aestivum*. The findings of these studies showed that this plant possesses anticancer properties [56].

Anti-inflammatory: Shah *et al.* investigated the anti-inflammatory activity of different extracts of *Triticum aestivum* in animal models. It was by carrageenan-induced paw edema using a plethysmometer in albino Wistar rats. Results of the study show that the extract possesses anti-inflammatory activity by comparing it with the Diclofenac sodium, use as a standard [57].

1.8 Introduction to the Family of *Tinospora Cordifolia*

Order: Ranunculales
Family: Menispermaceae
Genus: *Tinospora*
Species: *T. cordifolia*

In Hindi, the plant is commonly known as Giloy. It has recently become quite popular when it was said that it can cure swine flu. In Ayurveda literature, it is described as Amrita because of its innumerable medicinal properties. It also acts as a blood purifier. *Tinospora cordifolia* has been used in Ayurvedic rasayanas for centuries, which are very helpful in building up the immune system and the body's confrontation against the definite infecting organism. A constituent of *Tinospora cordifolia* belongs to different classes such as alkaloids, diterpenoid lactones, glycosides, steroids, sesquiterpenoids, phenolics, aliphatic compounds, and polysaccharides. They possess various medicinal properties [58].

1.9 Scientific Basis of Some of the Medicinal Properties of *Tinospora Cordifolia*

Immunomodulatory activity: Adhe *et al.* described the immunomodulatory activity of *Tinospora cordifolia* by determining different parameters, Delayed Type Hypersensitivity, and effect on the bone marrow cellularity and α-esterase cells by using zinc sulfate turbidity test [59]. Oral administration of alcoholic extract of the plant was found to increase foot pad thickness and in the zinc sulfate turbidity test, rats treated with extract showed serum with more turbidity which indicates the immunomodulatory effects of *Tinospora cordifolia.*

infection in human beings. The results of this study give credence to the antibacterial use of *A. barbadensis* gel and leaf [18].

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Antioxidant activity: Samson *et al.* analyzed the *in vivo* as well as the *in vitro* antioxidant activity of *Ocimum sanctum* in noise exposure. This experiment indicates that *Ocimum sanctum* has the potential for more evaluation as an ideal antioxidant for noise-induced oxidative stress [32].

Kath *et al.* investigated the antioxidant activity of leaf extract of *Ocimum sanctum* in animal models of peptic ulcer and explored a possible correlation between its antioxidant and antiulcer activities. Extract administration increased the levels of SOD signifying its antioxidant and antiulcer activity [33].

***Anticancer activity*:** Islam *et al.* designed a study to investigate the anti-neoplastic effect of the leaves of *Ocimum sanctum* against Ehrlich Ascites Carcinoma (EAC) in mice at different doses. Hematological studies reveal a significant decrease in RBC count and an increase in WBC counts in the extract of leaves of *Ocimum sanctum* treated animals [34].

Magesh *et al.* also used *Ocimum sanctum* extensively for its antitumor activity against human non-small cell lung carcinoma (NSCLC) A549 cells. The results of this study demonstrate that extract induces apoptosis in A549 cells via a mitochondria caspase-dependent pathway and inhibits the *in vivo* growth of lewis lung carcinoma, suggesting that extract of *Ocimum sanctum* can be applied to lung carcinoma as a chemopreventive candidate [35].

Several studies including Karthikeyan *et al.* proved that *Ocimum sanctum* plant extract has been shown to protect against chemically induced oral cancer and the development of skin papillomas in rodents [36].

Antifertility activity: Sethi *et al.* used the fresh leaves of *Ocimum sanctum* to study its effect on male reproductive function in male albino rabbits. 2 gram of leaves of *Ocimum sanctum* was administered to each rabbit for 30 days. A significant decline was noted in the sperm count. The result implies the potential use of *Ocimum sanctum* as an effective male contraceptive agent [37].

Seth *et al.* also showed a decrease in total sperm count, sperm motility, and weight of the testis by long-term feeding, approximately 3 months of *Ocimum sanctum* leaves to adult male and female albino rats together with a normal diet [38].

1.6 Introduction to the Family of *Triticum Aestivum*

Order: Cyperales
Family: Poaceae
Genus: *Triticum*
Species: *T. aestivum*

Wheat is the most important stable food crop for more than one-third of the world's population and contributes more calories and proteins to the world's diet than any other cereal crop. It is nutritious, easy to store and transport, and can be processed into various types of food [39]. Wheatgrass juice is inhaled as "Green blood" which is consumed to improve the hemoglobin concentration of blood as it contains mostly chlorophyll (about 70%). Wheatgrass is an excellent health-building food and is also called superb food [40, 41]. It contains 78.10% carbohydrates, 14.70% protein, 2.10% fat, 2.10% minerals, and considerable proportions of vitamins.

Wheat is also a good source of trace minerals like selenium and magnesium, nutrients essential to good health [42, 43, 44].

1.7 Scientific Basis of Some of the Medicinal Properties of *Triticum Aestivum*

Immunomodulatory activity: The study of Hemalatha *et al.* investigated the immunomodulatory activity of *Triticum aestivum* water extract in Swiss albino mice. Animals were challenged with Sleep Red Blood Cells and treated with *Triticum aestivum* and hematological, serological, and bone marrow cellularity evaluation was performed by collecting blood from the retro-orbital plexus. The finding confirms that the extract has a significant role in immunity [45].

Limbasiya *et al.* also studied the immunomodulatory effect of the hydroalcoholic extract of *Triticum aestivum* in different animal models by using a neutrophil adhesion test. From the results of the Limbasiya study, it was also concluded that the extract of wheatgrass has a significant effect on the immune system [46].

***Antidiabetic activity*:** Kothari *et al.* studied the antidiabetic activity of wheatgrass in normal rats. Administration of different doses of *Triticum aestivum* grass juice significantly reduced the total cholesterol, triglycerides, and low-density lipoprotein-cholesterol and shows that it possesses antidiabetic activity [47].

Antimicrobial activity: Das *et al.* were experimentally find out the antimicrobial activity of water extract of wheatgrass on gram-positive, gram-negative, and fungus. It was found that extracts of *Triticum aestivum* were active against the entire microorganism [48].

Jeong *et al*., Borchardt *et al.*, and Somani *et al.* evaluated the effectiveness of different extracts of *Triticum aestivum* for antibacterial activity against different bacterial strains by using paper-disc agar diffusion, disc diffusion, and kirby-bauer method respectively. The finding of these studies proves that the plant possesses good antimicrobial activity [49, 50, 51].

Antioxidant activity: Shukla *et al.* evaluated the antioxidant activity of aqueous and alcoholic extract of wheatgrass *in vitro* [52]. This study shows that *Triticum aestivum* possesses antioxidant activity.

Aydos *et al.* also evaluated the antioxidant activity of the same solvent extract by measuring different parameters such as catalase and SOD in chronic myeloid leukemia cell lines [53]. Kulkarni *et al.* also estimated the antioxidant activity of wheatgrass by employing different models and these models showed that *Triticum aestivum* possesses antioxidant activity [54].

Anticancer activity: Patel analyzed the anticancer property of *Triticum aestivum* on HeLa cells *in vitro* by using an MTT assay [55]. Tirgar *et al.* also evaluated the anticancer activity of isolated compounds of *Triticum aestivum*. The findings of these studies showed that this plant possesses anticancer properties [56].

Anti-inflammatory: Shah *et al.* investigated the anti-inflammatory activity of different extracts of *Triticum aestivum* in animal models. It was by carrageenan-induced paw edema using a plethysmometer in albino Wistar rats. Results of the study show that the extract possesses anti-inflammatory activity by comparing it with the Diclofenac sodium, use as a standard [57].

1.8 Introduction to the Family of *Tinospora Cordifolia*

Order: Ranunculales
Family: Menispermaceae
Genus: *Tinospora*
Species: *T. cordifolia*

In Hindi, the plant is commonly known as Giloy. It has recently become quite popular when it was said that it can cure swine flu. In Ayurveda literature, it is described as Amrita because of its innumerable medicinal properties. It also acts as a blood purifier. *Tinospora cordifolia* has been used in Ayurvedic rasayanas for centuries, which are very helpful in building up the immune system and the body's confrontation against the definite infecting organism. A constituent of *Tinospora cordifolia* belongs to different classes such as alkaloids, diterpenoid lactones, glycosides, steroids, sesquiterpenoids, phenolics, aliphatic compounds, and polysaccharides. They possess various medicinal properties [58].

1.9 Scientific Basis of Some of the Medicinal Properties of *Tinospora Cordifolia*

Immunomodulatory activity: Adhe *et al.* described the immunomodulatory activity of *Tinospora cordifolia* by determining different parameters, Delayed Type Hypersensitivity, and effect on the bone marrow cellularity and α-esterase cells by using zinc sulfate turbidity test [59]. Oral administration of alcoholic extract of the plant was found to increase foot pad thickness and in the zinc sulfate turbidity test, rats treated with extract showed serum with more turbidity which indicates the immunomodulatory effects of *Tinospora cordifolia.*

Ranjith *et al.* also studied the immunomodulatory activity of *Tinospora cordifolia* both *in vitro* and *in vivo.* The findings of the study reveal its immunomodulatory property [60].

Anti-diabetic activity: It has been used as an alternative medicine to treat diabetes mellitus. Puranik *et al.* studied to investigate the anti-diabetic activity of different doses of *Tinospora cordifolia* stem extract in streptozotocin-diabetic albino rats and also investigated the probable mechanism by which it might act as an anti-hyperglycemic drug. The results of this study clearly showed that it has significant anti-diabetic activity in diabetic animals [61].

The results of Verma *et al.* also showed that the root and stem extract of *Tinospora cordifolia* respectively are pancreatic protective and hypoglycemic [62].

Antimicrobial activity: Nagaprashanthi *et al.* and Duraipandiyan *et al.* also evaluated the antimicrobial activity of *Tinospora cordifolia* against different bacterial and fungal strains by using well and disc diffusion methods respectively [63, 64].

Antioxidant activity: Praveen *et al.* evaluated the antioxidant activity of different solvent extracts of *Tinospora cordifolia* through non-enzymatic *in vitro* models. The figure obtained in the *in vitro* models establishes the antioxidant potency of the leaf extracts of *Tinospora cordifolia* [65].

Prince *et al.* attempted to study the antioxidant property of *Tinospora cordifolia* roots, in alloxan diabetic rats. Oral administration of an aqueous root extract of this plant for 6 weeks resulted in a decrease in the levels of plasma thiobarbituric acid reactive substances, ceruloplasmin, and alpha-tocopherol in alloxan diabetic rats [66].

Mathew *et al.* also showed that it possesses antioxidant activity and its usefulness in the amelioration of cyclophosphamide-induced toxicity [67].

Anticancer activity: Gulati *et al.* was demonstrating that *Tinospora cordifolia* killed the HeLa cells very effectively [68] and Tungpradit *et al.* isolated the active anticancer compound from this plant. Both the study proves that *Tinospora cordifolia* acts as a potential antineoplastic agent [69].

Verma *et al.* used the *Tinospora cordifolia* to study the anticarcinogenic activity in C57Bl mice. C57Bl mice fed with the extract of plant *Tinospora cordifolia* at different doses for 30 days showed an increase in life span and tumor size was significantly reduced as compared to the control. The result of this study suggests that the plant possesses anticarcinogenic activity [70].

***Antimalarial activity*:** Singh Singh *et al.* mentioned in their experimental studies that the extract of *Tinospora cordifolia* exhibited a strong *antimalarial effect* [71, 72].

Antiobesity activity: Dinesh *et al.* investigated the effect of stem extract of *Tinospora cordifolia* on obesity in rats. Obesity was induced in rats by using sulpiride drugs. Administration of plant extract showed a significant antiobesity effect in sulpiride-induced obese rats, which indicated the potential of *Tinospora cordifolia* stem extract in the treatment of obesity [73].

1.10 Introduction to the Family of *Azadirachta Indica*

Order: Rules
Family: Meliacea
Genus: *Azadirachta*
Species: *indica*

The divine tree *Azadirachta indica* (Neem) is mainly cultivated in the Indian subcontinent. It is an omnipotent tree and a sacred gift of nature. *Azadirachta indica* is a member of the mahogany family, Meliacea, and has been used extensively by humankind to treat various ailments from prehistoric times. The means of *Azadirachta indica* is "free tree of India". It is the most useful traditional medicinal plant in India. Each part of the neem tree has some medicinal properties [74]. Neem has been extensively used in Ayurveda, Unani, and Homeopathic medicine and has become a cynosure of modern medicine. Chemical investigation of the products of the neem tree was extensively undertaken in the middle of the twentieth century. More than 135 compounds have been isolated from different parts of neem and several reviews have also been published on the chemistry and structural diversity of these compounds [75]. The compounds have been divided into two major classes: isoprenoids and nonisoprenoids.

Isoprenoids include diterpenoids and triterpenoids.

Nonisoprenoids include proteins, carbohydrates, sulfurous, polyphenolics, aliphatic compounds, etc.

1.11 Scientific Basis of Some of the Medicinal Properties of *Azadirachta Indica*

Immunomodulatory activity: Shah *et al.* evaluated the immunomodulatory activity of aqueous extract of *Azadirachta indica* flowers in the humoral and cell-mediated immune response to ovalbumin, phagocytic activity by carbon clearance test and cyclophosphamide-induced myelosuppression. This study reveals that the extract holds promise as an immunomodulatory agent, which acts by stimulating both specific and nonspecific immune responses [76].