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Ashutosh Kumar
Research Scholar, Department of Pharmacy, Rameshwaram Institute of technology and Management Sitapur Road, Lucknow, Uttar Pradesh, India

Vipin Rao Sonkar
Assistant Professor, Department of Pharmacy, Rameshwaram Institute of technology and Management Sitapur Road, Lucknow, Uttar Pradesh, India

Pragati Singh
Assistant Professor, Department of Pharmacy, Rameshwaram Institute of technology and Management Sitapur Road, Lucknow, Uttar Pradesh, India

Nancy Tiwari
Assistant Professor, Department of Pharmacy, Khwaja Moinuddin Chishti Language University, Lucknow, Uttar Pradesh, India

Corresponding Author:
Vipin Rao Sonkar
Assistant Professor, Department of Pharmacy, Rameshwaram Institute of technology and Management Sitapur Road, Lucknow, Uttar Pradesh, India

In-vitro evaluation of scavenging and antimicrobial activity of *Betula utilis* leaves extract

Ashutosh Kumar, Vipin Rao Sonkar, Pragati Singh and Nancy Tiwari

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Abstract
The popularity of herbal medicine has surged worldwide due to its natural origins, particularly in combating drug-resistant pathogens. Recent growth in this field is driven by the urgent need for effective treatments. Modern techniques are increasingly used to identify and isolate bioactive compounds from medicinal plants, showing promise against various pathogens. Despite advancements, many antimicrobial medicines are still plant-derived. *Betula utilis* leaves have long been used for medicinal purposes, and a current study is evaluating their antibacterial, antifungal, and antioxidant properties. This research aims to address current challenges and explore future perspectives in utilizing medicinal plants for antimicrobial purposes, recognizing the complexities involved in their efficacy.

Keywords: *Betula utilis*, herbal medicines, bioactive compounds, antimicrobial activity, antioxidant

Introduction

Microbien Infections

Considering the enormous advancements made in medical research, infectious illnesses brought on by pathogens such as parasites, fungi, viruses, continue to pose a significant risk to the health of humanity. According to the limited supply of medications and the rise of extensive resistance to medication, their influence is especially significant in nations that are developing (Okeke *et al*., 2005) [1]. In terms of infectious illnesses, fungi infections are more common in people's health issues, especially in women and children. Skin conditions are a serious and common problem in some poor nations as well as fungus infections. According to Deepti *et al.* (2012) [2], bacteria rank top among the most common pathogens that cause infectious conditions and account for a significant portion of the worldwide burden of sickness.

Antimicrobial Activity

Plant compounds as well as their constituent parts are recognised as exhibiting biological impacts, including those that are antimicrobial properties antifungal, antibacterial and antioxidants. Opportunities for the development of new antimicrobial agents may include compounds that can suppress infections while being relatively benign to host cells (Bajpai *et al*., 2005) [3]. Therapeutic plant elements with the value stems, and roots, leaves, bark, flowers, and fruits contain these chemicals. Alkaloids, tannins, flavonoids, and phenolic ingredients are the most significant of these therapeutic substances. Numerous compounds found in botanicals have the potential to stop microbial diseases. In addition to being useful in treating contagious disorders, antibacterial agents derived from plants also have a great deal of medicinal potential and can often reduce many of the negative consequences of synthetic antimicrobial agents. Plants can create antimicrobial chemicals to defend their cells against biotic threats that may be necessary for infections by microbes, in addition to using crude plant extracts for their antimicrobial properties. As a result, it is important to research the ability of both plants and their derivatives to inhibit the growth of microbes (Kan *et al*., 2009) [4]. The antibacterial qualities of plant-based medicines have been more widely recognised in recent years.

Free Radical Scavenging

Persons are becoming more aware of preventing illnesses in the past few decades, particularly regarding the function of radicals that are free in wellness and illness. The body's regular usage of oxygen results in the constant production of radicals that are free (Tiwari, 2004) [5]. Oxygen is an essential component of life. Antioxidants are created through the enzyme mitochondria whenever cells use oxygen for creating energy.

ROS and reactive nitrogen species (RNS), which are pollutants of the biological redox procedure, are the most common types of these consequences (Sivanandham, 2011) [6].

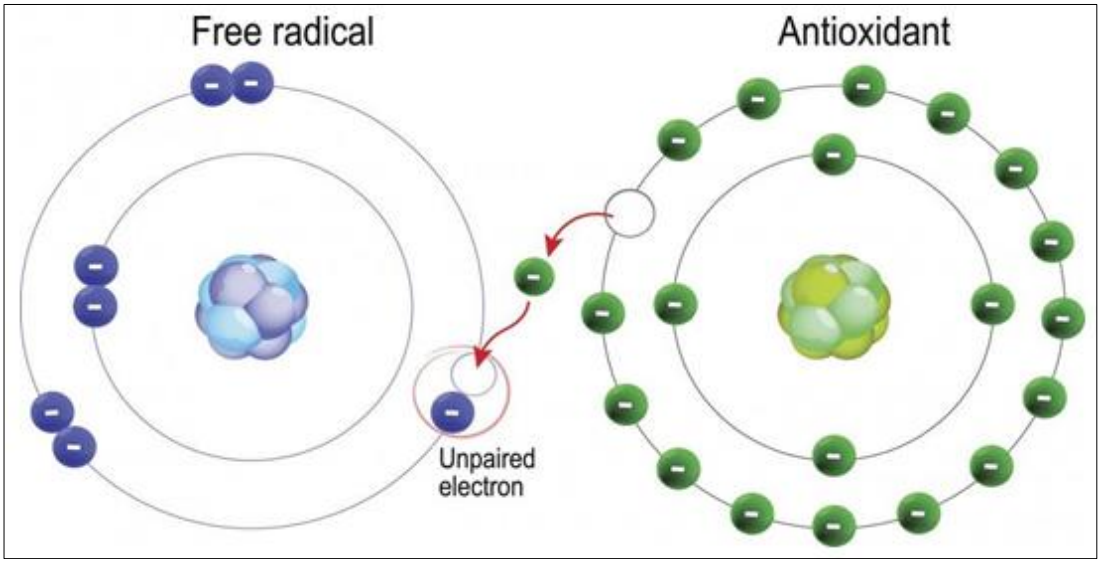


Fig 1: Free radicals, how they affect the body

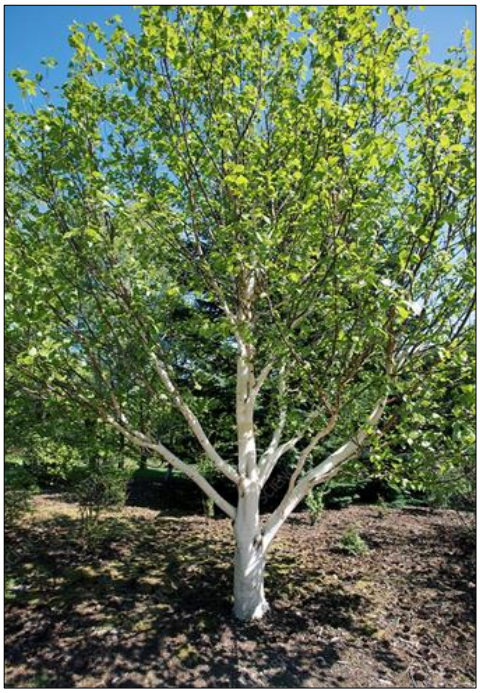
The organism might benefit from free radicals or suffer harm from them. Oxidative stress is a situation that develops in the body as soon as there is an equilibrium in the generation and elimination of radicals that are free. The body possesses preventive mechanisms called antioxidants that can reduce the frequency of certain individual orbidities and fatalities in order to combat these harmful free radicals.

***Betula utilis*: Plant Profile**

The mountain birch, *Betula utilis*, called bhojpatra, belongs a tree with no leaves that is indigenous to the western Himalayan and can reach heights of up to 4,500 m (14,800 ft). The word "useful" comes from the Latin word utilis, which describes the various uses for which the tree's various components can be put. Around the world, there are numerous branded varieties and variations used in landscape. Many varieties of the tree possess orange and copper-colored wood in the eastern part of its natural area. Because numerous cultivars have particularly white bark, *Betula utilis* var. jacquemontii, coming from the west end of the natural setting, is frequently employed (Biswasroy *et al*., 2022) [7].

Taxonomical classification

Kingdom: Plantae
Clade: Tracheophytes
Clade: Angiosperms
Clade: Eudicots
Clade: Rosids
Order: Fagales
Family: Betulaceae
Genus: *Betula*
Species: Utilis



Source: Science Photo Library

Fig 2: Depiction *Betula utilis* plant

Phytochemistry

According to the significant incorporation of triterpenoids in such as the acids betulinic as well as oleanolic acid, compounds are renowned because of their cancer fighting abilities, the bark of the birch tree has been the focus of scientific study and business in the contemporary era. Betulinic acid is a brand-new apoptosis-inducing anticancer medication (Ehrhardt *et al*., 2004; Fulda *et al*., 1997) [8]. It differentiates from traditional chemotherapy medications as a result. These substances and flavonoids are two more types of chemicals found in B. utilis species (Keinanen *et al*., 1998) [9].

Selection and Authentication

The selected *Betula utilis* leaves were obtained from a local area of Lucknow in the month of March 2023 and authentication shall be done from the taxonomic division of GIPS, Lucknow, Uttar Pradesh (Betula 01/2023/002).

Extraction of drug

The collected *Betula utilis* leaves were air dried and followed by tray dryer under favorable condition and powdered it. The powdered crude drug was extract out with increasing polarity of verity of solvents such as Benzene, $CHCl_3$, EA and Aq. successively by Soxhlet extractor. The crude solution was further filtered and make syrupy mass by reduced pressure at 40 °C and kept in desiccator.

Antibacterial and Antifungal Assays

Nutrient media

The pH (at 35 °C) being regulated to 7.3 0.2, 28 grammes of Mueller Hinton Agar powdered was placed in 1000 cc of purified water, and cultured agar was then heated to thoroughly disintegrate the culture. Following gushing, the medium used was autoclaved for 15 minutes at 121 °C and 15 Ibf /sq inch temperature to sterilise it (Rimek *et al*. 2008) [10].

Mueller-Hinton Agar Ingredients

Ingredients	Quantity (g/l)
Beef extract	350.0
Acid digest casein	19.6
Agar	18.14g
Starch	8.1

Nutrient Agar

Ingredients	Quantity (g/l)
Powdered Beef extract	15. 25
Peptone extract	12. 0
Sodium chloride	9. 5
Sugar	6. 23
Agar	12. 56

Cultured pH (at 35 °C) were regulated to 7.3 0.2, 28 grammes of Mueller Hinton Agar powdered were placed in 1000 ml of filtered water-based, and the agar was then heated to sufficiently disintegrate the media. Prior to the pouring process, the medium was autoclaved over 15 minutes at 121 °C and 15 Ibf/sq inch temperature to sterilize it.

Bacterial and fungal pathogens

Throughout the current investigation, isolates of bacteria from gram-positive organism gram negative in and fungus species were employed. For microbiological and antifungal stock communities, correspondingly, Muller Hinton Agar and Sabouraud Dextrose, or Liquid have been stored at 4 °C. the isolates collected in Biotechnology Park in Lucknow. Employing a mixture of Muller Hinton Broth (MHB) and Muller Hinton Agar (MHA), experimentally antimicrobial properties were assessed. Employing fungus acquired from Himedia Ltd., Mumbai, both Sabouraud Dextrose Agar (SDA) as well as Sabouraud Dextrose Broth (SDB) served to test in vitro antifungal activity of the compounds.

Formation of Inoculum

The clarity of the solution was adjusted through the addition of sterilized physiological saltwater before a 0.5 Mac Farland turbidity measurement (106 CFU/ml) was established, which was accomplished by mixing a 24-hour-old culture of chosen microorganisms with a solution of physiological saline. The mold-like fungus has been cultured on SDA then incubated for four consecutive days at 35 °C. In order to standardize the fungal solution via spectroscopy to an intensity of 0.600 at 530 nm, the development was removed thoroughly, smashed, and completely boiled in sterilized water that was distilled (Peleg *et al*. 2010) [11].

Test solution Preparation

Specified weights of natural extracts were utilized to make the testing approaches, which were then submerged in DMSO (DMeSO) at a concentration of 5%. 20 l of the extraction were sprayed onto 6 mm Whatmann No. 1 sterilized filtration discs, which were then left to air-dry at a comfortable temperature.

Sterility check

To verify the purity of the ingredients, all of the isolates had streaks applied on MHA and SDA dishes. Following storage (24 h for microorganisms), and 72 for fungi) the plates were observed.

Disc diffusing approach

Using preparations' preliminary antimicrobial activity was evaluated using the agar diffusing approach (Bonev *et al*., 2008) [12]. For the ability to resist test towards mounds and bacteria, 20 ml of MHA as well as SDA were poured into petri plates and permitted to harden. Sheets were properly spread after drying. After draining the extra inoculums, the plates were left to dry for 5 minutes. Using a sterilised forceps, the disc containing the extracted substances was put on the plate's surface after washing and lightly pushed to make contact against the marinated agar substrate. As an encouraging control, ketoconazole in (10 g/disc) was utilised for antifungal while ciprofloxacin (5 g/disc) for bacterium. Throughout these tests, a blind control at a concentration of DMSO of 5% was employed. The inoculation dishes were subsequently left to incubate for bacteria for 24 hours at 37 °C and for fungus for 72 hours at 28 °C. We watched and took a millimeter measurement of the inhibitory zone. In this study, each test was carried out on three occasions.

Minimum Inhibitory Concentration (MIC)

The MIC of several herbal extracts in MHB for bacterium and the SDB for fungus. For achieving a dosage of 2 mg/ml, the botanical isolates were immersed in 5% DMSO, and 0.5 ml comprising a stock solution has been added to 0.5 ml of MHB to generate concentrations of 1000, 500, 250, 125, 62.5, 31.2, as well as 15.6 g/ml. 50 regular liters. The experiment's microorganism was injected through each tube in incubation. The experimental tube wasn't made up of any extracts of

plants but it nevertheless comprised living things. The culture containers were treated with bacteria for 24 hours at 37 °C and with fungi for 72 hours at 28 °C. The MIC was established as the lowest doses that occurred when the studied bacterium stopped growing, as established by macroscopic analysis. The assay was repeated three times (Andrews *et al*., 2001) [13].

Bacterial identification

The present investigation was carried out with seven pure clinical isolates bacterial strains which obtained from Dept. of Biotechnology, GITM Lucknow. These clinical isolates microbes were analyzed and confirmed with some morphological observation. It was followed based on Bergey's Manual of Systematic Bacteriology Vol I & II modified by Krieg and Holts (1984) [1] descriptions.

Préparation A

Crystal violet	4.0 g
95% Ethanol	20 ml

Préparation B

Ammonium oxalate	0.9 g
DW	80 ml

Preparation A and B were mixed with Gram's iodine solution

Iodine	2.0g
KI	1.0g
DW	320 ml

Preparation of grams iodide solution Acetone alcohol

Ethyl alcohol (95%)	700 ml
Acetone	300 ml

Safranine	0.5 g
Distilled water	100 ml

Safranine (0.5%) solution

Evaluation of the radical scavenging effects

DPPH radical antioxidant Assay

Okawa (2001) [14] examined DPPH radical scavenger properties of the various A plant extracts component preparations.

Reagents

- DPPH (1, 1-diphenyl-2-picrylhydrazyl hydrate).
- Methanol (0.2mM).
- Vitamin C.

Procedure

A separate preparation of each sample (0.1 ml) was combined with 1 ml of 0.2 mM DPPH suspended in formaldehyde. The quantities used were 125, 250, 500, and 1000 g/ml. The resultant mixture was left to sit at 28 ºC in the dark for 20 minutes. The control plate was implemented as a blank which contained every reagent needed but no sample. A spectrum analyzer (Hitachi U-20) was used to measure the wavelength at 517 nm in order to assess the activity of the DPPH radical scavenging process. Positive controls, such as vitamin C, were employed. The IC_{50}, whose is characterized as the level of isolates needed to suppress the production of radicals produced by DPPH by 50% (Izuta *et al*., 2009) [15] was used to demonstrate the antioxidant properties of plant preparations.

The expression that follows was used to get the radical DPPH intensity

$$\text{Percentage of inhibition} = \frac{\text{Absorbance of control- Absorbance of sample}}{\text{Absorbance of control}} \times 100$$

Hydrogen Peroxide Scavenging Effects

That (Al-Amiery *et al*. 2015) [16] technique was used to assess the effectiveness of multiple extracts from plants.

Ingredients

- 0.1M Phosphate buffer solution at pH 7.4.
- 40mM H_2O2 mixed with buffer solution.
- Ascorbic acid.

Assay

In the buffer with phosphates, a mixture of Hydrogen peroxide (40 mM) was generated. The H_2O_2 mixture (0.6 ml) was mixed with several natural extracts at varied levels of concentration (125, 250, 500, as well as 1000 g/ml), resulting in an end result of 3 ml. At 230 nm, the reaction mixture's fluorescence was measured using a spectrum analyzer (Hitachi U20). As an advantageous control, buffered phosphate and the antioxidant vitamin C were added to an empty solution. This equation was used to determine how much H_2O_2 the extracts of plants were able to scavenge.

$$\text{Percentage of inhibition} = \frac{\text{Absorbance of control- Absorbance of sample}}{\text{Absorbance of control}} \times 100$$

Statistical Analysis

The findings of animal tests were performed as a mean standard deviation (standard deviation). GraphPad Prim version 6.03 program, GraphPad prizm, Inc. was used to do mathematical comparisons utilizing the Newman-Keuls method after one-way ANOVA.

Results

Table 1: Physical characteristics of leaves extracts

Characteristics	Benzene	Chloroform	Ethyl acetate	Aqueous
Physical appearance	Semisolid mass	Semisolid mass	Semisolid mass	Semisolid mass
Color	Yellowish green	Yellowish Brown	Buff color	Greenish black
Odour	Characteristics	Odor less	Characteristics	Characteristics
Taste	Acrid	Characteristics	Acrid	Salted

Physicochemical parameters

The findings of above analysis of powdered *Betula utilis* leaves as expressed in Table 2. All parameters' findings are represented as a% age of shade dried plant specimen.

Table 2: Physicochemical analysis of crude powder of *Betula utilis* leaves

S. No.	Particulars	Percentage (% wt/wt)
1.	LOD	02.46
2.	Total ash	04.53
3.	Water soluble ash	2.81
4.	Acid insoluble ash	0.89
5.	Sulphate ash	1.87

Extractive value

Table 3: Age yield of extractive value%

S. No	Solvents	Weight of the powdered sample (100 g)% Yield
1	Benzene	3.5
2	Chloroform	6.4
3	Ethyl acetate	8.2
4	Water	11.2

Preliminary Chemical test: Qualitative chemical tests were completed for crude soluble of *Betula utilis* leaves to identify different phytoconstituents is shown in Table 4.

Table 4: Summery of preliminary phytochemical screening of *Betula utilis* leaves extract

Phytoconstituents class	Benzene	Chloroform	Ethyl acetate	Water
Alkaloid				
Hager's Reagent	-	+	++	+++
Mayer's Reagent	-	-		++
Sugar				
Fehling's Reagent	+	+	+	-
Barfoed's Reagent	-	-	-	+++
Molish's Reagent	-	+	-	+
Benedict's Reagent	+	+	+	+
Fixed oils and fats				
Filter paper test	+	--	-	+
AAs & Peptides				
Biuret's Reagent	+	+	-	-
Ninhydrin Reagent	+	+++	++	+
Millon' Reagent	-	++	+	+
Flavonoid				
$FeCl_3$ solution	-	-	++	+++
Alkaline test	-	+	++	+++
Pb $(CH_3COO)_2$) Solution	-	--	++	++
Zinc chloride acid reduction	+	--	+	+++
Shinoda's test	-	+	++	+++
Test for sterols				
Salkowaski test	++	+++	-	-
For saponin				
Froth solution	-	-	-	++
For nonreducing carbohydrates				
Iodine solution	-	-	+	
Tannic acid solution	-	-	+	++
Polyphenols				
$FeCl_3$ solution	-	+	++	+++

Whereas + = Present; ++; moderately present; +++ = Strongly present;-= Absent

Table 5: The antibacterial and antifungal properties of several BUL preparations

Microorgan isms	Mean inhibition Zone (mm)[b]											
	Benzene			Chloroform			Ethyl acetate			Water		
	250	500	1000	250	500	1000	250	500	1000	250	500	1000
S. Aureus	8.6±0.28	9.0±0.11	11.3±0.28	8.6±0.28	9.5±0.28	13.0±0.0	11.3±0.28	12.5±0.28	14.3±0.11	12.1±0.10	15.3±0.15	19.1±0.15
B. Cereus	8.0±0.05	8.6±0.11	9.5±0.20	8.1±0.10	9.0±0.10	11.3±0.28	8.1±0.11	9.3±0.15	12.0±0.50	8.1±0.15	10.3±0.15	14.6±0.76
B. Subtilis	7.2±0.17	8.3±0.28	9.7±0.25	7.6±0.28	9.0±0.00	11.3±0.11	8.0±0.11	10.0±0.11	11.4±0.20	8.3±0.15	10.1±0.15	12.5±0.10
E. coli	NA	NA	NA	7.0±0.20	8.1±0.10	9.2±0.20	7.2±0.10	8.3±0.10	9.5±0.20	8.1±0.15	9.3 ±0.15	10.6±0.28
K. pneumoniae	7.2±0.20	7.6±0.28	8.0±0.11	9.5±0.200	10.2±0.25	10.7±0.10	9.6±0.10	10.3±0.17	12.3±0.28	9.7±0.25	10.6 ±0.20	12.3±0.28
P. aeruginosa	7.2±0.10	7.6±0.28	8.2±0.25	8.3±0.15	9.5±0.20	11.1±0.10	9.6±0.15	10.2±0.20	12.5±0.0	10.0±0.20	10.8 ±0.15	13.1±0.28
S. typhi	7.0±0.10	8.1±0.10	9.1±0.10	8.0±0.11	9.5±0.15	10.1±0.11	9.7±0.10	10.3±0.28	12.6±0.1	12.1±0.36	14.7 ±0.20	16.1±0.15
A. niger	7.0±0.0	7.5±0.0	8.0±0.0	7.1±0.28	8.6±0.28	9.5±0.28	7.2±0.25	8.1±0.28	9.0±0.11	8.1±0.10	9.4 ±0.11	10.6±0.10
fumigatus	7.6±0.28	8.1±0.10	9.1±0.28	7.8±0.28	8.6±0.15	9.2±0.20	8.9±0.11	9.6±0.15	10.1±0.15	9.3±0.10	10.3 ±0.15	12.3±0.10
A. flavus	7.2±0.10	7.6±0.28	8.4±0.10	7.6±0.28	8.3±0.28	8.6±0.10	8.0±0.11	8.5±0.20	9.0±0.1 1	9.4±0.10	10.2 ±0.05	10.3±0.15

[a]-diameter of ZOI (mm) having vessel diameter 6mm, [b]-mean± SD; Ciprofloxacin (5µg/disc)-for bacteria between 22 and 29 mm; Ketoconazole (10µg/disc)-for fungus between 12 and 13mm, (NA-No inhibitory Activity)

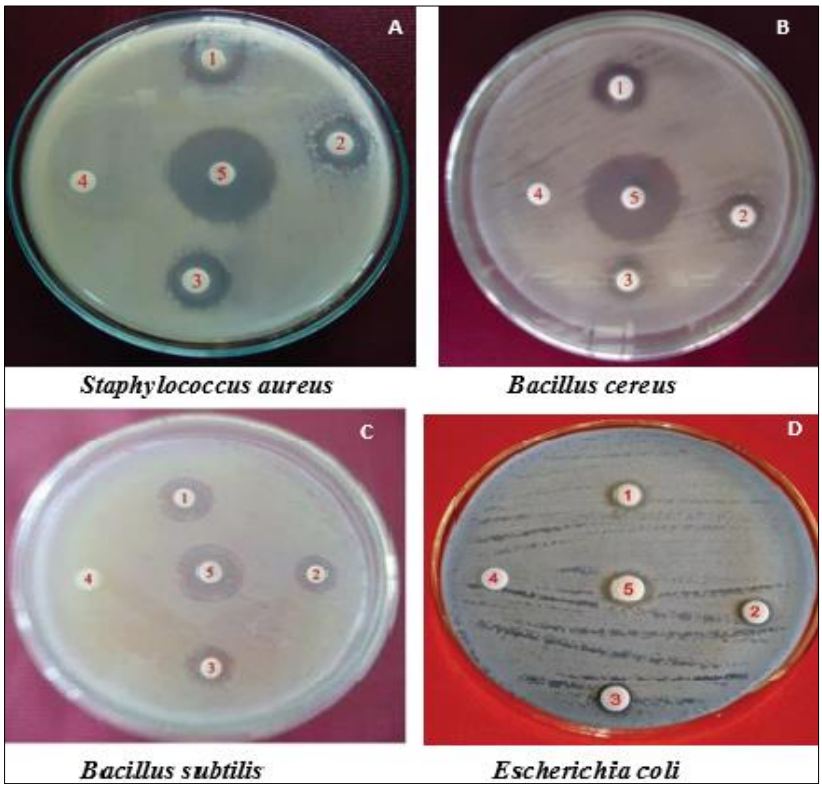
Antimicrobial activity of the *Betula utilis* leaves [BUL]

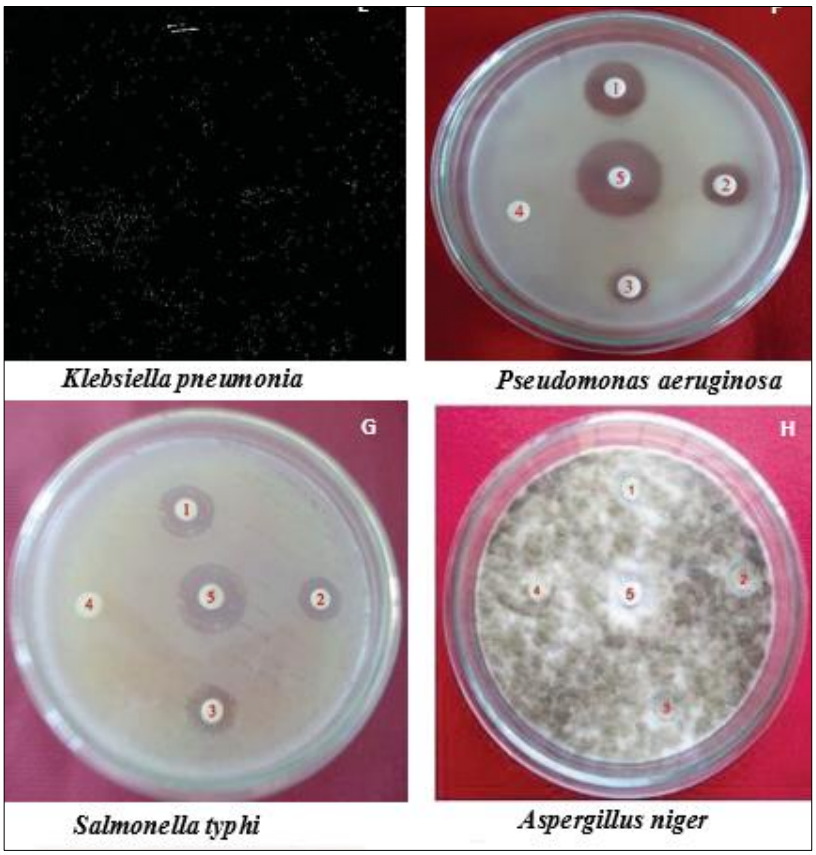
Varying doses of have varying antibacterial activity of Benzene, $CHCl_3$, EA, and Water extracts of BUL are presented in Table 5. The water and ethyl acetate extracts of root had higher attributes towards mentioned the organisms studied. The mean zone of inhibition for water extract of BUL

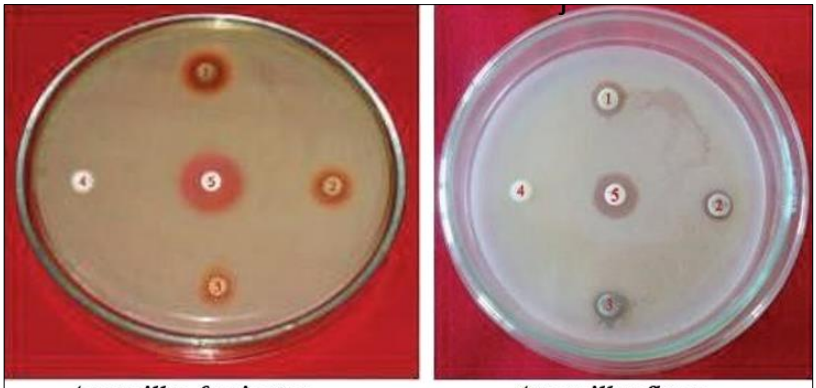
ranged from 8.1 to 19.1 mm. The ZOI for the Ciprofloxacin in addition to Ketoconazole positive control groups varied between 29 to 13 mm. The ethyl acetate extract showed moderate activity against the rest of the microorganisms. The zone of inhibition was found to be highest in chloroform extract against *Staphylococcus aureus* (13.0 mm/ 1000 µg/disc). The chloroform extract showed less activity against Escherichia coli (7.0 mm). The Benzene extract showed no inhibitory reduced action towards most of the species and more efficacy towards E. coli Plates 3 and 4).

Inhibitory Minimal Concentration (MIC), Bactericidal Minimal Concentration (MBC), as well as Fungicidal Minimum Concentration (MFC) of BUL

Applying the tube diluting approach, the MIC that allowed the preparations that killed the bacteria was identified. With gramme positive bacteria, the extracts made from water showed a greater MIC, although was ineffective against the remaining test species. Strong MIC, MBC, and MFC results across all of the species examined indicate that the benzene solutions were least efficient.







1-1000 µg/disc; 2-500 µg/disc; 3-250 µg/disc; 4-Blind Control (5% DMSO); 5-Control.

Fig 3: Antimicrobial activity of the AEBU

Antioxidant Screening: Tables 6 and 7 demonstrate the extract's capacity to scavenge DPPH radicals. The leaf section has a greater capacity than the remainder to neutralise damaging free radicals.

Table 6: Antioxidant DPPH scavenging activity of AEBU

							Applied Concentration	Abs.	Inhibition Conc.
Control	0 mg	0 ml	0 ml	0 ml	2 ml	2 ml	0 mg/ml	0.627	
Gallic acid	10.2 mg	100 ml	1ml	10 ml	0.1 ml	2 ml	0.00051 mg/ml	0.518	17.38437
	10.2 mg	100 ml	1ml	10 ml	0.2 m l	2 ml	0.00102 mg/ml	0.444	29.186603
	10.2 mg	100 ml	1ml	10 ml	0.4 m l	2 ml	0.00204 mg/ml	0.28	55.342903
	10.2 mg	100 ml	1ml	10 ml	0.6 ml	2 ml	0.00306 mg/ml	0.095	84.848485
	10.2 mg	100 ml	1ml	10 ml	0.8 ml	2 ml	0.00408 mg/ml	0.058	90.749601

Table 7: Determination of IC_{50} of AEBU leaves

							Applied Concentration	Abs.	Inhibition Conc.
MEBU	50.2 mg	50 ml	1 ml	1 ml	0.5 ml	2 ml	0.251 mg/ml	0.453	27.751196
	50.2 mg	50 ml	1 ml	1 ml	1 ml	2 ml	0.502 mg/ml	0.286	54.385965
	50.2 mg	50 ml	1 ml	1 ml	2ml	2ml	1.004 mg/ml	0.216	65.550239

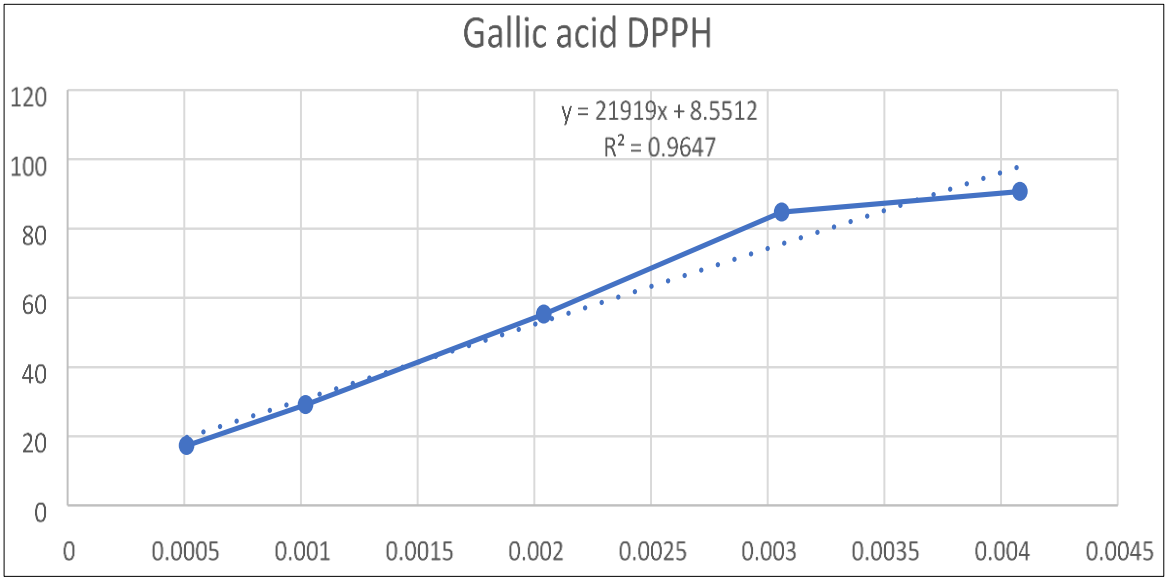


Fig 4: Antioxidant capacity of AEBU with reference to Gallic acid

Discussion

Ancient systems of medicine, modern medicine, nutritional supplements, functional foods, folk remedies, pharmaceutics, and biochemical entities for manufactured medications all rely on herbal medicines being their primary source of bioactive compounds. The existence of phytochemical compounds, flavonoids, glycosides, phenolic compounds, tannin, saponins, and terpenoids may contribute to medicinal plants healing powers. In conventional healers, the *Betula utilis* plant is often used to cure a variety of diseases. But statements about the effectiveness of interventions have been expressed lacking any supporting evidence. The study in question was carried out to support certain of the conventional uses for this botanical. The inquiry focused on the pharmacological, phytochemical, quantitative, antioxidants, effects that the *Betula utilis* plant's leaf. Bioactive chemicals are extracted from plant-based substances is the first step in

the identification, isolation and standardization of phytochemicals.

We followed the sequential extraction method using four raising the polarity of several solvents as an including benzene, $CHCL_3$, EA, as well as Aq. Phenolics and flavonoids can be extracted from fresh, frozen or air-dried plant samples. Usually before extraction, plant samples after drying should be milled, grinded and homogenized. A current investigation, shade-drying was performed to the plant sample to preserve the constituent profiles so that medicinal properties of plant would not be destroyed.

The prime agents that lead to various diseases are the pathogenic microorganisms. The need for new and effective medicinal products for managing infections involving bacteria and fungi has arisen as a result of the overuse of antibacterial agents for the management of transmission, and this has led to the creation of impermeable strains of bacteria which raise the probability of therapy collapse. Numerous compounds found in herbs have the potential to be used as antibiotics. In order to find new antibacterial chemicals from vegetation, many investigations have been undertaken conducted.

Staphylococcus aureus, *Bacillus cereus*, *Bacillus subtilis*, *Escherichia coli*, *Klebsiella pneumonia*, *Pseudomonas aeruginosa*, *Salmonella typhi*, and all three fungal strains, *Aspergillus Niger*, *Aspergillus fumigatus*, *along with Aspergillus flavus*, have been tested to investigate the antibacterial and antifungal properties of *Betula utilis* the leaves.

The extract from methanol was shown to have the greatest region of suppression, following through the ethyl acetate, chloroform, and Benzene preparations. Gramme positive, gramme negative, and fungal infections were all inhibited by *Betula utilis* leaves. The Aqueous extract from leaves demonstrated the greatest efficacy when used against investigated infections caused by bacteria and fungi.

As a result, the present investigation clearly demonstrates the therapeutic benefit of what plants *Betula utilis* and provides reliable evidence for its usage in pharmaceutical formulations.

Conclusions

Contemporary medicine's fundamental understanding base is derived from vegetation. Nearly every part of a plant, including its leaves, branches, roots, fruits, flowers, barks, and seeds, is recognized as possessing some sort of therapeutic use. The use of plants for medicinal purposes has become more popular, and potent plant-based extracts are regularly checked for the existence of antioxidant substances, antimicrobials, and novel drugs. Oxidative stress, a process which is mediated by free radicals, is thought to represent the root cause for numerous illnesses including diabetes, tumors, cataracts, arthritis, heart disease, and senescence. Antioxidants medication has become increasingly significant in the management of various disorders in recent years. The majority of novel medicinally valuable compounds discovered for creation of medications come from botanicals. Plants with a long history of usage as medicines create a variety of substances with proven therapeutic effects. New antibacterial medication prospects are those compounds that either eradicate or hinder the growth of infections while being more or less hazardous to host cells. More and more reports of the antibacterial capabilities of herbal remedies are coming in regularly from all over worldwide.

Betula utilis leaves were the source of matter employed in the current investigation. Despite the fact that the parts are employed throughout conventional medicine to treat a variety of illnesses, particularly those caused by microbial infections, little research has been done on the specifics of its antibacterial effects and botanical compounds role. Therefore, the goal of the current study was to evaluate the detoxification potential of *Betula utilis* leaves as well as their antimicrobial and antifungal properties towards infections that affect humans.

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References

1. Okeke IN, Laxmaninarayan R, Bhutta ZA, Duse AG, Jenkins P, O'Brien TF, et al. Antimicrobial resistance in developing countries. Part 1: Recent trends and current status. Lancet Infectious Diseases. 2005;5:481-493.
2. Deepti RA, Permender RB, Sushila RB, Dharmender R. Phytochemical screening and antimicrobial activity of Picrorrhiza kurroa, an Indian traditional plant used to treat chronic diarrhoea. Arabian J Chem; c2012. http://dx.doi.org/10.1016/j.arabjc.2012.02.009.
3. Bajpai M, Pande A, Tewari SK, Prakash D. Phenolic contents and antioxidant activity of some food and medicinal plants. Inter J Food Sci Nutri. 2005;56(4):287-291.
4. Kan A, Özçelik B, Karta M. *In vitro* antiviral activities under cytotoxic doses against herpes simplex type-1 and parainfluenza-3 viruses of *Cicer arietinum* L. (Chickpea). African J Pharmacy Pharmacol. 2009;3(12):627-631.
5. Tiwari AK. Antioxidants: New-generation therapeutic base for treatment of polygenic disorders. Curr Sci. 2004;86(8):1092-1102.
6. Sivanandham V. Free radicals in health and diseases-Pharmacology Online. 2011:1062-1077.
7. Biswasroy P, Pradhan D, Sahu DK, Rai V, Halder J, Rajwar TK, et al. Phytochemical investigation, structural elucidation, in silico study and anti-psoriatic activity of potent bioactive from *Betula utilis*. J Biomol Struct Dyn. 2022 Oct 10:1-16. EPUB Ahead of Print. PMID: 36214696. DOI: 10.1080/07391102.2022.2130981.
8. Ehrhardt H, Fulda S, Ahrer FM, Debatin KM, Jeremias I. Betulinic acid-induced apoptosis in leukemia cells. Leukemia. 2004;18:1406-1412.
9. Keinanen M, Tiitto JR. High-performance liquid chromatographic determination of flavonoids in Betula pendula and Betula pubescens leaves. J Chromatogr. 1998;793:370-377.

10. Rimek D, Fehse B, Göpel P. Evaluation of Mueller-Hinton-agar as a simple medium for the germ tube production of *Candida albicans* and *Candida dubliniensis*. Mycoses. 2008 May;51(3):205-8. DOI: 10.1111/j.1439-0507.2007.01469.x. PMID: 18399901. https://doi.org/10.1111/j.1439-0507.2007.01469.x
11. Peleg AY, Hogan DA, Mylonakis E. Medically important bacterial-fungal interactions. Nat Rev Microbiol. 2010 May:8(5):340-9. DOI: 10.1038/nrmicro2313. EPUB 2010 Mar 29. PMID: 20348933.
12. Bonev B, Hooper J, Parisot J. Principles of assessing bacterial susceptibility to antibiotics using the agar diffusion method. J Antimicrob Chemother. 2008 Jun;61(6):1295-301. DOI: 10.1093/jac/dkn090. EPUB 2008 Mar 12. PMID: 18339637.
13. Andrews JM. Determination of minimum inhibitory concentrations. J Antimicrob Chemother. 2001 Jul;48 Suppl 1:5-16. DOI: 10.1093/jac/48.suppl_1.5. Erratum in: J Antimicrob Chemother 2002 Jun;49(6):1049. PMID: 11420333.
14. Okawa M, Kinjo J, Nohara T, Ono M. DPPH (1, 1-diphenyl-2-picrylhydrazyl) radical scavenging activity of flavonoids obtained from some medicinal plants. Biol Pharm Bull. 2001 Oct;24(10):1202-5. PMID: 11642334. DOI: 10.1248/bpb.24.1202
15. Izuta H, Narahara Y, Shimazawa M, Mishima S, Kondo S, Hara H. 1, 1-diphenyl-2-picrylhydrazyl radical scavenging activity of bee products and their constituents determined by ESR. Biol. Pharm Bull. 2009 Dec:32(12):1947-51. DOI: 10.1248/bpb.32.1947. PMID: 19952409.
16. Al-Amiery AA, Al-Majedy YK, Kadhum AA, Mohamad AB. Hydrogen peroxide scavenging activity of novel coumarins synthesized using different approaches. PLOS One. 2015 Jul 6:10(7):e0132175. PMID: 26147722. DOI: 10.1371/journal.pone.0132175. PMCID: PMC4492988.
17. Krieg NR, Holt JG, Editors. Bergey's Manual of Systematic Bacteriology; c1984 Aug 17. Vol. I.