DINABANDHU ANDREWS COLLEGE
NAAC Accredited
(Government Sponsored)
Estd. 1956

Ref. No. ..... Date .....

NAME OF THE COLLEGE/ INSTITUTION- Rabindra Mahaviyalaya

DATE OF MOU- 28/11/2019

PURPOSE OF MOU- Both the Parties are pleased to enter upon an agreement to establish ties of academic cooperation in order to contribute to the achievement of their overall goals as institutions through following but not limited to:

1. Joint teaching and research projects.
2. Collaboration in the area of academic publications, research activities, field trips etc.
3. Visit, training and exchange of faculty, staff and students
4. Joint educational/vocational courses.
5. Joint consultancy, PhD. supervision, scientific publications.
6. Co-hosting and participation in conferences, seminars, symposiums and workshops.

ACTIVITIES-

1. Faculty Exchange Programme
2. Research Collaboration Activities
3. Seminar

Baishnabghata, P.O. Garia, Dist. 24 Parganas (S), Kolkata - 700 084
Ph. : (033) 2430 4377, e-mail : dacprincipal@gmail.com. website : www.dacollege.org

**RABINDRA MAHAVIDYALAYA**
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**54, Raja S.C. Mallick Road, Baishnabghata,**
**Kolkata-- 700084**
**E-mail:** dacprincipal@gmail.com
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# FACULTY EXCHANGE PROGRAMME

Between Rabindra Mahavidyalaya and Dinabandhu Andrews College Under Memorandum of Understanding (MOU) Dated: 17.08.2023

| | | | |
|---|---|---|---|
| 1. | Name of the Faculty Member | Dr. JOYDIP GHOSH | |
| 2. | Name of the Department | MICRO-BIOLOGY | |
| 3. | Name of the College of the Faculty Member | RABINDRA MAHAVIDYALAYA HOOGHLY | |
| 4. | Date of Faculty Exchange Programme | 19.01.2024 | |
| 5. | Type of Lecture (Tick any one) | ✓ | Discipline Specific |
| | | | Inter Disciplinary |
| | | | Multi-Disciplinary |
| 6. | If Inter Disciplinary or Multi-Disciplinary mention the conducted Department | | |
| 7. | Name of the Topic | Nitrogen Fixation | |
| 8. | Number of Students attended the lecture | | |
| 9. | Feedback from the faculty member about the programme | | |

Signature of the Principal of the Host College

Principal
Dinabandhu Andrews College
Garia Kolkata-700 084

Joydip Ghosh
Signature of the faculty Member participating in the Faculty Exchange Programmer

Joy Sarkar
Signature of the IQAC Coordinator/ IQAC member of the Host College

Coordinator, IQAC
Dinabandhu Andrews College

**RABINDRA MAHAVIDYALAYA**
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# FACULTY EXCHANGE PROGRAMME

Between Rabindra Mahavidyalaya and Dinabandhu Andrews College Under Memorandum of Understanding (MOU) Dated: _____

## STUDENT ATTENDANCE SHEET

| Sl No. | Name /Signature of the Students | Sl No. | Name /Signature of the Students |
|---|---|---|---|
| 1. | Arinpam Ghosh | 18. | Nitika Samanta |
| 2. | Arpita Sarkar | 19. | Swastika Acharya |
| 3. | Shreestha Maiti | 20. | Sadhana Shaw |
| 4. | Yogesh Daksmo | 21. | Somali Chowdhury |
| 5. | Arabinka Ghosh. | 22. | Susmita Dutta |
| 6. | Chhandasik Dasgupta | 23. | Soumi Mandal |
| 7. | Mrityunjoy Bagchi | 24. | Sohini Banerjee |
| 8. | Sayan Naskar | | |
| 9. | Bidisha Datta | | |
| 10. | Sneha Bhattacharjee | | |
| 11. | Utsab De | | |
| 12. | Malay Shubhra Singha | | |
| 13. | Sayandeep Biswas. | | |
| 14. | Srejeeb Chowdhury | | |
| 15. | Priyajeet Ghosh. | | |
| 16. | Sayani Naskar | | |
| 17. | Swati Das. | | |

Signature of the Principal of the Host College

Principal
Dinabandhu Andrews College
Garia Kolkata-700 084

Joydip Ghosh

Signature of the faculty Member participating in the Faculty Exchange Programmer

Joy Sarkar

Signature of the IQAC Coordinator/ IQAC member of the Host College

Coordinator, IQAC
Dinabandhu Andrews College

# DINABANDHU ANDREWS COLLEGE

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*Ref. No.* .....

*Date* 19.01.24

**Dated:**

## TO WHOM IT MAY CONCERN

This is to certify that Dr./ Sri/ Smt ...Joydip Ghosh.....of Dinabandhu Andrews College conducted a Class/..... Classes / Lecture for the students of the Department of ....Microbiology.....,

Semester ....III..... On ..19.01.2024..... at _____(Host College) under the Faculty Exchange Programme of the Memorandum of Understanding (MOU), Dated ___.

Principal
Dinabandhu Andrews College
Garia Kolkata-700 084

**Dr. Somnath Mukhopadhyay**
**Principal,**
**Dinabandhu Andrews College, Kolkata**

Baishnabghata, P.O. Garia, Dist. 24 Parganas (S), Kolkata - 700 084
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# RABINDRA MAHAVIDYALAYA

Affiliated to the University of Burdwan

Champadanga, Hooghly, West Bengal, Pin.– 712401

Estd. – 1971

NAAC (Cycle-2) Accredited B++ Institution


Ref. No.....

Date.....

## To Whom It May Concern

This is to certify that Dr. Tanmay Ghosh, Assistant Professor in Microbiology, Dinabandhu Andrews College, Raja SC Mallick Road, Baishnabghata, 24 Parganas(South), Kolkata, has presented Invited Lectures for the academic benefit of our students. It was in accordance with a Faculty Exchange Programme organized as per the Memorandum of Understanding signed between our College and the aforementioned Institution where Dr. Tanmay Ghosh works as a Full Time Teacher.

| Topic | Date & Time |
|---|---|
| Soil Microbiology.<br>Practical. | 14.09.2023, 11.00 AM -- 4.00 PM |

Date: 14.09.2023

PRINCIPAL

Dr. Prasanta Bhattacharyya

Principal

Rabindra Mahavidyalaya

Champadanga, Hooghly

Noted

18/09/2023

Principal

Dinabandhu Andrews College

Garia, Kolkata-700 084

**ISSN: 2582-8118** ***Volume 1, Issue 3; May 2021***

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# 3. A Study on the Antibacterial Activities and Medical Properties of Water Chestnut

**Tanmay Ghosh**
*Department of Microbiology, Dinabandhu Andrews College, Baishnabghata, South 24 Parganas, Kolkata, West Bengal, India.*

**Joydip Ghosh**
*Department of Microbiology, Rabindra Mahavidyalaya, Champadanga, West Bengal, India.*

## ***ABSTRACT***

*Fruits and vegetables are generally known as very good and abundant sources of several vitamins and minerals, not only that but also they are very effective in increasing immunity power against several microbial infections.*

*In the matter of discussion of preventing bacterial infections the underwater vegetables are not staying back. One of the very effective and used under water vegetable is Water Chestnut. Water chestnut is not a nut at all, but it is a very useful aquatic vegetable that grows under Water in the mud. Eleocharisdulcis, belongs to family Cyperaceae, commonly called Chinese water chestnut. It was stem-like, its green leaves grow to about 1.5m.*

*The small, round forms have crisp. White stuff may be eaten fresh, boiled grilled and also used as pickled. Water Chestnuts are popular dishes in china. It also used for making many cake or delicious food. It is grown in many countries like Asia (china, India & Japan etc.), Africa, Australia, and Island. Water chestnut used in agricultural department. It also plays important role in medical Field to development medical science.*

*Its peels extracts, seed used for product many type of medicine. It showed a high-level antibacterial activity against some bacteria like Bacillus subtilis, Escherichia coli, Salmonella typhi etc. In medicinal field this plant use to cured many type of diseases like inflammation, urinary, discharges, fractures, leprosy, astringents, bad teeth and malaria.*

## ***KEYWORDS***

*Water Chestnut, Microbiology, Pharmaceutical Sciences, Biology.*

## Introduction:

Water chestnut is not a nut at all, but it is a very useful aquatic vegetable that grows under Water in the mud. Eleocharis dulcis, belongs to family Cyperaceae, commonly called Chinese water chestnut. It was stem-like, it's green leaves grow to about 1.5m.

The small, round forms have crisp. White stuff may be eaten fresh, boiled grilled and also used as pickled. Water Chestnuts are popular dishes in china. It also used for making many cake or delicious food. It is grown in many countries like Asia (china, India & Japan etc.), Africa, Australia, and Island. Water chestnut used in agricultural department. It also plays important role in medical Field to development medical science. Its peels extracts, seed used for product many type of medicine It showed a high-level antibacterial activity against some bacteria like Bacillus subtilis, Escherichia coli, Salmonella typhi etc.

In medicinal field this plant use to cured many type of diseases like inflammation, urinary, discharges, fractures, leprosy, astringents, bad teeth and malaria.

**Fig.1: Water Chestnut**

## Taxonomy classification of Water Chestnut

- Kingdom: Plantae
- Clade: Tracheophytes
- Clade: Angiosperms
- Clade: Monocots
- Clade: Commelinids
- Order: Poales
- Family: Cyperaceae
- Genus: Eleocharis
- Species: E. dulcis

## Materials and Methods

### Collection of Plant

The plant water chestnut was taken for study on its antimicrobial activity and antibacterial significance of water chestnut collected from Champadanga, Hooghly, and West Bengal.

### Preparation of Plant Extract

At first we washed the plant peels with distilled water and kept them for dry under shade, and grind them with the help of mixer grinder to a dust powder. And keep it in an air tight container at the room temperature in dark until used.

The powdered samples are extracted by the following methods.

- **Ether Extraction** To prepare the Ether extraction first, 5mg of dried of water chestnuts peel extract powder mixed with 25ml ether to each solution was stored at 4°C after collecting in sterile test tubes until use.
- **Hexane Extraction** About 5 gm of dried Water Chestnut peel extract powder taken, then dispersed in 25 ml of benzene solution and shaken in a rotary shaker for 10 minutes. Then closed with paper and tightened with a band few holes were made in the paper to facilitate air circulation and room temperature maintenance for 5 dates.
- **Benzene Extraction** About 5 gm of dried Water Chestnut peel extract powder taken, then dispersed in 25 ml of benzene solution and shaken in a rotary shaker for 10 minutes. Then closed with paper and tightened with a band. Few holes were made in the paper to facilitate air circulation and room temperature maintenance for 5 dates.
- **Chloroform Extraction** For making Chloroform extraction 5mg of dried of water chestnut peel extract powder mixed with 25ml Chloroform. Each solution was stored at 4°C after collecting in sterile test tubes until use.
- **Ethanol Extraction** First, 5mg of dried of water chestnut peel extract powder mixed with 25ml Ethyl Acetate. Each solution was stored at 4°C after collecting in sterile test tubes until use.
- **Ethanol Extraction** For preparing the Ethanol extraction, 5mg of dried of water chestnut peel extract powder mixed with 25ml ethanol. Each solution was stored at 4°C after collecting in sterile test tubes until use.
- **Medium** In this we use Mueller Hinton agar (MHA) is used as base medium for the screening of antibacterial activity and Mueller Hinton broth (MHB) is used for the preparation of inoculums.

### Preparation of Extract Concentration

Four concentrations were made 25, 50, 100, 200mg/ml from each of the four extract Ethanol, Benzene extract, Chloroform, Ethyl acetate and Ether. In every case 1gm of extract was mixed with 5ml DMSO to prepare 200mg/ml stock concentration. Other concentrations were made by adding extra DMSO with stock in other test tube.

## Determination of Antibacterial Activity

## Bacterial Stains

We take bacteria such as Bacillus subtilis, Escherichia coli and Salmonella typhi bacteria were selected for antibacterial activity test. The cultures of bacteria were maintained in their appropriate agar slants at 4°C throughout the study and used as stock cultures.

## Preparation of Bacterial Inoculum

Bacterial inoculums were prepared by 0.1 ml of cultures was transferred to the agar plates and incubated at 370C for 4-5 hours.

## Agar Diffusion Methods

Agar well diffusion method is widely used to evaluate the antimicrobial activity of plant. This phenomenon forms the basis of the agar diffusion assay that is used to determine the susceptibility or resistance of a bacterial strain to an antibacterial agent. Disc diffusion method was carried on Mueller Hinton agar plates.

Petri plates were prepared by 20ml of Mueller Hinton agar and allowed to solidify for the use in susceptibility test against bacteria. Plates were dried and 0.1ml of inoculums was poured and spread and allow to dry. After the cork borer agar well made on agar plate and poured different concentration of extract into the well. The Penicillin is used as positive control and DMSO was used as negative or blind control. The plates were incubated at 370C for 1 day.

The zone of inhibition were observed and measured. The agar plates were incubated at 4°C for 1hour and were then incubated also at 37°C. After 24 to 48 hours of incubation, the antibacterial activity was evaluated by measuring the width of zone of inhibition of growth against the indicator organisms in comparison to a control of reference standards. The tests were study in triplicate.

## Phytochemical Analysis

Phytochemical analysis of all the evaporated solvent ex-tracts was conducted following the procedure of Indian Pharmacopoeia (1985).

- **Test For Alkaloids** For testing of alkaloids first we take 200 mg plant material in 10 ml methanol, (filtered) and a 2ml filtrate + 1% HCl + steam mixed and then 1 ml filtrate + 6 drops of Mayer's reagents or Wagner's reagent added then the creamish precipitate/brownish-red
  Precipitate/orange precipitate found that indicated the presence of respective alkaloids.
- **Test For Tannins** For testing of tannins 200 mg plant material in 10 ml distilled water added (filtered), a 2 ml filtrate + 2 ml FeCl3 mixed then blue-black precipitate that indicated found the presence of tannins.

- **Test For Flavonoids** For testing of flavonoids 200 mg plant material in 10 ml ethanol (filtered), a 2 ml filtrate + conc. HCl + magnesium mixed and then ribbon pink-tomato red color indicated the presence of flavonoids.
- **Test For Steroids** For testing of steroids we follow the Liebermann - Burchard reaction and there we take 200 mg plant material in 10 ml chloroform, (filtered), a 2 ml filtrate + 2 ml acetic anhydride + conc. H2SO4 was added then the founded Blue-green ring indicated the presence of steroids.
- **Test For Phenols** For testing of phenols first 1ml of each solvent extracts dissolved in alcohol or water was separately treated with a few ml of neutral ferric chloride solution.
  The change in color indicated the presence of phenols.

**Table 1: Phytochemical Analysis**

| No | Phytochemical | Method | Result |
|---|---|---|---|
| 1 | Tannin | Ferric chloride test | - |
| 2 | Flavonoid | Alkaline Reagent test | + |
| 3 | Phenol | Ferric chloride test | - |
| 4 | Carbohydrate | Molisch's test | + |
| 5 | Protein | Biuret test | + |
| 6 | Sapronin | Foam test | - |
| 7 | Starch | Iodine Test | +++ |

## Result

Antibacterial activity of water chestnut peel extract against bacterial culture of Escherichia coli, Bacillus subtilis, salmonella typhi etc. It help in to examine inhibition zone. Antibacterial activity of water chestnuts peels extract against many type potential of many extract. The extract of water chestnut showed antibacterial efficiency against many organisms like Bacillus subtilis, Escherichia coli, and Salmonella typhi. Pore efficiency was found against the Staphylococcus aureus.

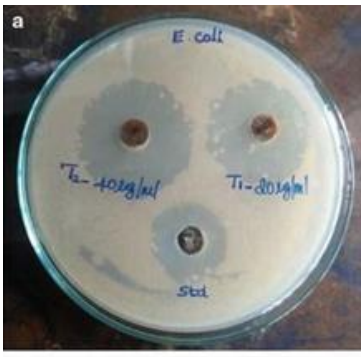


**Fig.2: Escherichia coli.**

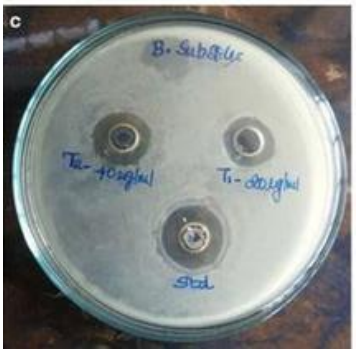


**Fig.3: Bacillus subtilis**

**Table-2: The antimicrobial activity of Chloroform extract against different bacteria**

| Concentration (mg/ml) | Zone of inhibition (mm) | | | |
|---|---|---|---|---|
| | ***Staphylococcus aureus*** | ***Escherichia coli*** | ***Bacillus subtilis*** | ***Salmonella typhi*** |
| 200 mg/ml | 29.0±2 | 25.2±1 | 26.3±1 | 31.5±2 |
| 100 mg/ml | 24.7±2 | 24.2±2 | 26.7±2 | 26.1±1 |
| 50mg/ml | 22.7±1 | 20.5±1 | 21.9±1 | 21.9±2 |
| 25mg/ml | 18.2±2 | 18.7±2 | 17.5±2 | 18.6±1 |

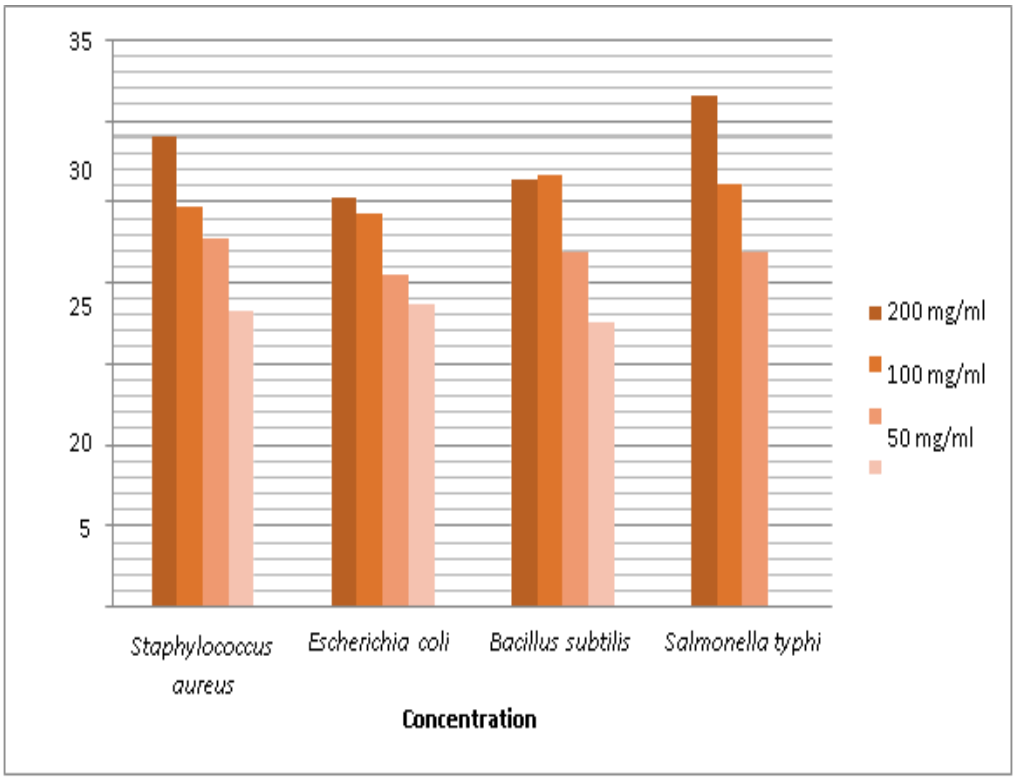


**Fig 4: The antimicrobial activity of chloroform extracts against different bacteria**

**Table-3: The antimicrobial activity of Ethanol extract against different bacteria**

| Concentration (mg/ml) | Zone of inhibition (mm) | | | |
|---|---|---|---|---|
| | ***Staphylococcus aureus*** | ***Escherichia coli*** | ***Bacillus subtilis*** | ***Salmonella typhi*** |
| 200 mg/ml | 22.1±2 | 26.1±1 | 26.3±1 | 30.5±2 |
| 100 mg/ml | 24.6±2 | 24.2±2 | 25.7±2 | 26.1±1 |
| 50mg/ml | 18.9±1 | 21.1±1 | 23.4±2 | 30.1±2 |
| 25mg/ml | 17.2±2 | 22.9±2 | 17.5±2 | 19.1±1 |

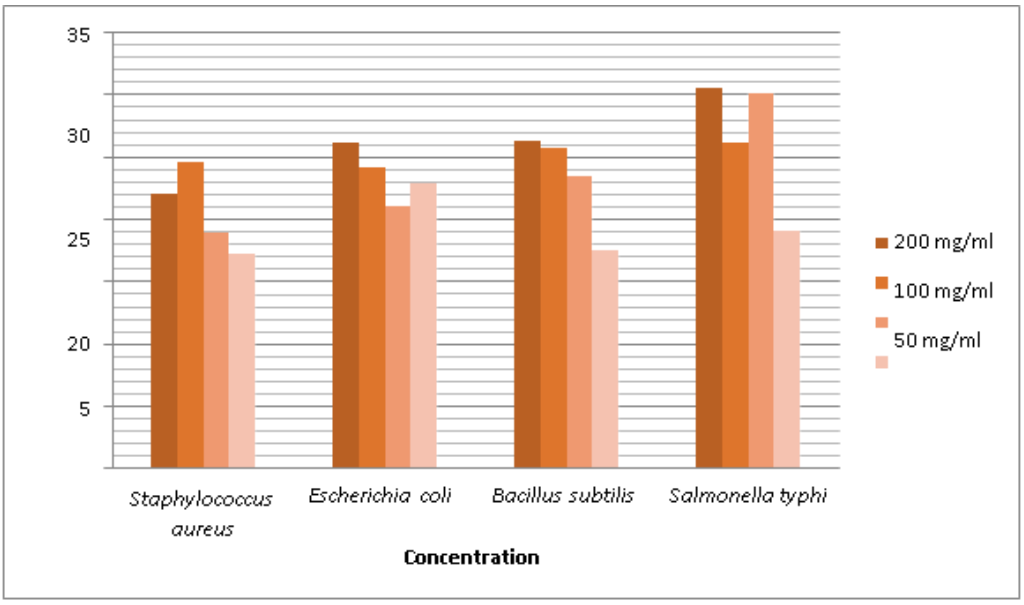


**Fig 5: The antimicrobial activity of Ethanol extract against different bacteria**

**Table-4: The antimicrobial activity of Ethanol extract against different bacteria**

| **Concentration (mg/ml)** | **Zone of inhibition (mm)** | | | |
|---|---|---|---|---|
| | ***Staphylococcus aureus*** | ***Escherichia coli*** | ***Bacillus subtilis*** | ***Salmonella typhi*** |
| 200mg/ml | 22.1±2 | 26.1±1 | 26.3±1 | 30.5±2 |
| 100mg/ml | 24.6±2 | 24.2±2 | 25.7±2 | 26.1±1 |
| 50mg/ml | 18.9±1 | 21.1±1 | 23.4±2 | 30.1±2 |
| 25mg/ml | 17.2±2 | 22.9±2 | 17.5±2 | 19.1±1 |

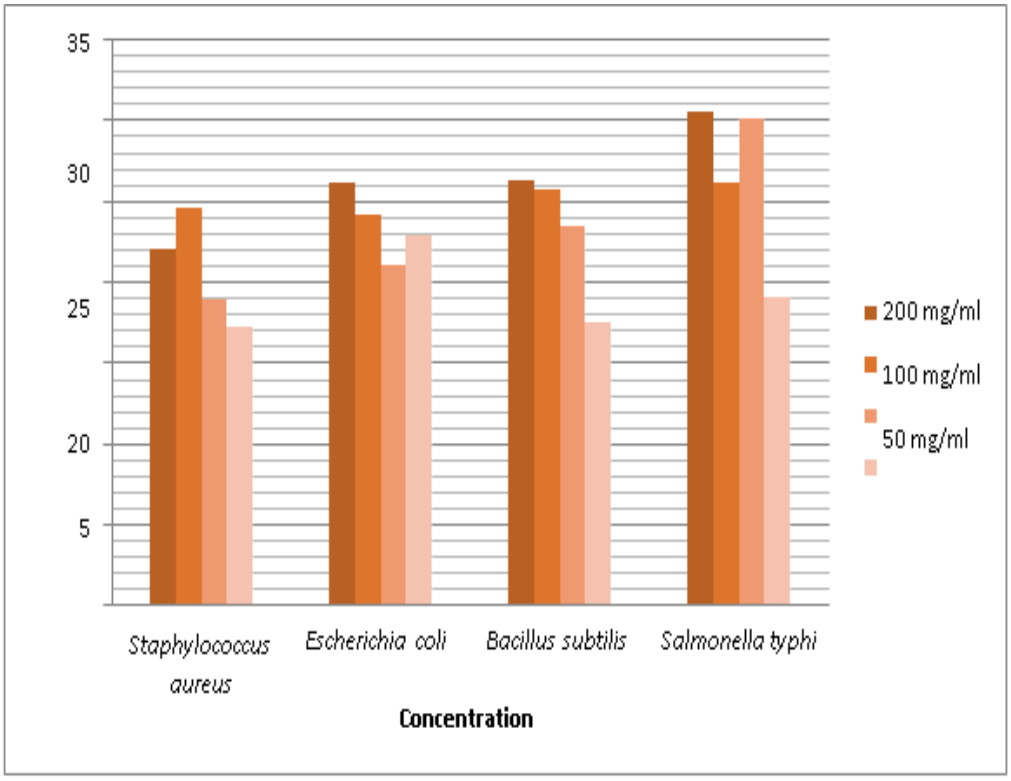


**Fig 6: The antimicrobial activity of Ethanol extract against different bacteria.**

**Table-5: The antimicrobial activity of Benzene extract against different bacteria**

| Concentration (mg/ml) | Zone of inhibition (mm) | | | |
|---|---|---|---|---|
| | ***Staphylococcus aureus*** | ***Escherichia coli*** | ***Bacillus subtilis*** | ***Salmonella typhi*** |
| 200mg/ml | 26.9±2 | 27.4±1 | 25.8±1 | 28.5±2 |
| 100mg/ml | 19.4±2 | 23.4±2 | 26.1±2 | 30.1±1 |
| 50mg/ml | 22.4±1 | 22 .9±1 | 24.3±2 | 31.2±2 |
| 25mg/ml | 17.5±2 | 18.1±2 | 15.9±2 | 18.3±1 |

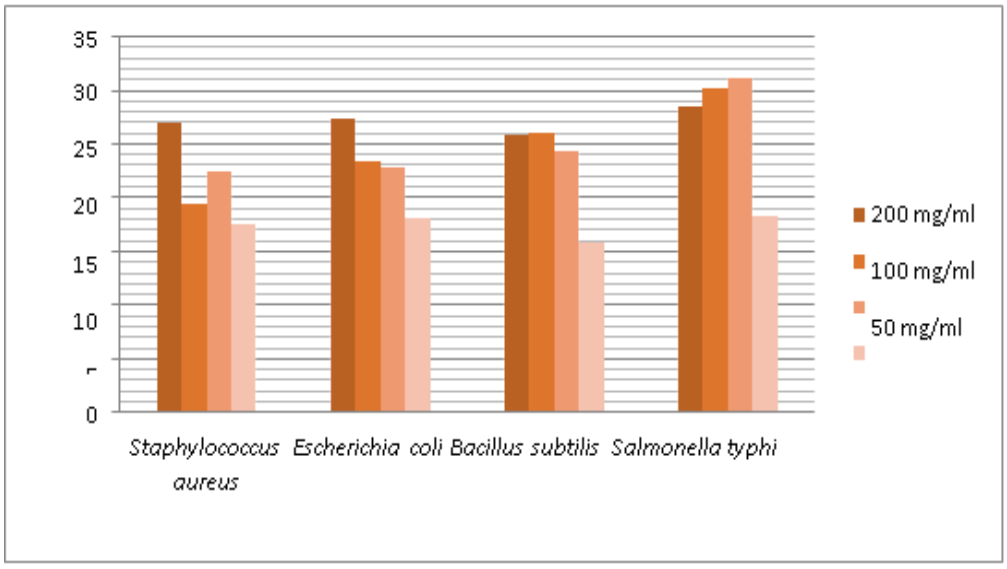


**Fig 7: The antimicrobial activity of Benzene extract against different bacteria**

## Discussion

The methanol extract of water chestnut fruit was found as very important antibacterial activity that inhibits both Gram positive and Gram negative bacteria. It helps to increase of antibacterial resistance of various microorganisms.

From result it seemed that water chestnut showed low antibacterial activity on staphylococcus aureus then other bacteria. Water chestnut showed high efficiency against Bacillus subtilis, salmonella typhi and Escherichia coli. Water chestnut play very important role in medical field to produce various type of medicines. It's effective process help to control infection of many diseases.

## Conclusion

In this paper we observed that phytochemical property of fruit to analyze their quality for their use. Hexane, Benzene, Chloroform, Ethanol extract physicochemical test showed positive result. It can be conclude that water chestnut showed antibacterial activity against many bacteria.

It helps to control infection of many diseases. This plant contains medicinally important compound that use in medical field for the treatment of various diseases. This plant helps in development medical field.

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Research Paper

DI: 5909-1402-079

# An Understanding of Fungal Diversity of Cereal and Oil Seed Crops Particularly in Coastal Region Composed to Indo-Gangetic Areas and their Eco-friendly Management

**Tanmay Ghosh*[1], Joydip Ghosh[2], Maitreyee Mondal[3] and Subhasree Roy[4]**

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Received: 14 February 2020; Revised accepted: 22 March 2020

## A B S T R A C T

This study deals with the isolation of fungal communities and comparison seed borne mycoflora between Coastal zone seeds (Digha; West Bengal) and Indo-gangetic areas (Burdwan, Hooghly, Howrah; West Bengal) and to identify and classify them by standard blotter method and agar plate technique. Coastal areas seed samples were collected from the sea side of Bay of Bengal, Digha, West Bengal and the Indo-gangetic areas seed samples were collected from Burdwan, Hooghly, Howrah; West Bengal. The seeds were stored in sterile screw cap bottles for further analysis. Phenotypic and genotypic characterization of fungal isolates were done using above tow methods. Six fungal genera including *Aspergillus sp., Penicillium sp., Rhizopus sp., Mucor sp., Alternaria sp., Macrophomina sp.* Of them *Aspergillus sp.* and *Alternaria sp.* are the most frequent members. It was found that the rate of germination of coastal zone seeds were more than the rate of germination of Indo-gangetic zones seeds. Whereas the fungal community of coastal areas were appeared more frequent and destructive than indo-gangetic region. The germination percentage of oil seeds of indo-gangetic areas appeared respectively 92% and 96% where the germination percentage of oil seeds of coastal region appeared respectively 64% and 72%, and the germination percentage of cereal crops of indo-gangetic areas (Pratiksha, Swarna, Khas, Minikit, Kalma) appeared respectively 88%, 92%, 84%, 96%, 80%. Whereas the germination percentage of all those cereal crops (Protiksha, Swarna, Khas, Minikit, Kalma) of coastal region appeared respectively 60%, 68%, 56%, 72% and 52%. In the other hand the appearance of fungal community were more frequent of coastal areas than indo-gangetic region. The percentage of fungal growth of oil seed of indo-gangetic region (oil seeds) were respectively 35% and 20%. Whereas in coastal areas it was respectively 50% and 45%. The fungal growth of different cereal crops (Protiksha, Swarna, Khas, Minikit, Kalma) of indo-gangetic and coastal areas were respectively (20%, 18%, 25%, 15%, 28%) and (38%, 35%, 40%, 30%, 44%).

**Key words:** Standard blotter method, Fungal community, Phenotypic, Agar plate technique, Destructive, Genotypic

India is one of the major cereal crops and oil seeds grower and importer. The diverse agro ecological conditions in the country are favorable for growing annual cereal crops and oil seeds. Ninety percent of food crops are propagated by seed. A most widely grown crops in agriculture zone (wheat, rice, maize, sesame, nut, mustard) are affected by various seed-borne diseases. A seed-borne pathogen present externally or internally or associated with the seed as contaminant may cause seed abortion, seed necrosis, reduction or elimination of germination capacity as

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well as seedling damage resulting in development of disease at later stages of seed growth (Fakhrunnisa *et al*. 2006). The literature on seed mycoflora of species was revealed and observed by several workers. Fungi including *Aspergillus sp., Penicillium sp., Rhizopus sp.,Mucor sp., Alternaria sp., Macrophomina sp.* have been found associated with the seeds of cereal crop and oil seeds. Among these, *Alternaria sp.* as well as *Aspergillus sp.* are known to be the most destructive pathogen of those seeds. Fungi are fundamental organisms in our ecological systems and will be found anywhere where the environment will support their growth, both on Indo-gangetic area and Coastal zone. However our understanding of fungal diversity particularly in marine environment (Digha, West Bengal) compared to Indo-gangetic areas (Burdwan, Hooghly, Howrah).

*Mechanism of seed infection by fungi*

Fungal infection of seed borne pathogens may reach the ovule of the seed at any stage from the initiation of ovule formation to the mature seed. The fungal plant pathogens vary in their modes of multiplication and attack on the lost plant (Chernin and Chet 2002, Ping and Boland 2004, Wei *et al*. 1991, Zhang and Birch 1996) fungal propagules / spores germinate and the growing hyphae determine the entry of the pathogens in plant tissue including the fruit and seed. The ovule and the seed develop in the pistil which is enclosed by other floral appendages in the flower and seed. The position and structure of seed, including the physical environment during seed development, determines the successful seed infection. The physiological and biochemical factors inside the fruit and seed further control the establishment of successful infection. Fungi may be biotroph (obligate parasite) or necrotroph (saprophytic). Biotroph cause minimal damage to the host seed, have a narrow host range, while necrotrophs cause apparent damage to the host cell and have a wide host range. The fungi, depending upon the time of infection and environment condition cause superficial or deep infection. Biotrophs usually establish deeper into the tissues including embryo. Necrotroph which degrade tissues through their enzymatic activity, as they spread, are rarely transmitted to the embryo through the mother plant. The mechanism of infection of the ovule and seed is also dependent upon the nature of disease in the plant and the mechanism of transmission of infection into the seed (Van *et al*. 1998, Kushi and Khare 1978).

*Important seed borne disease of oil seeds and cereal crops*

Any infectious agent associated with the seed, having the potential of causing a disease of a seedling or a plant, is termed as seed borne pathogens. In this case seed may or may not exhibit disease symptoms. This term includes all plant pathogenic microorganisms (fungi, bacteria, nematode) and the viruses which are carried in, on or with the seed (Limonard 1968).

| Crop | Disease | Pathogens |
|---|---|---|
| Wheat | Loose smut | *Ustilago segetum* var. *tritici* |
| | Black point | *Alternaria tritici* |
| | Head blight | *Fusarium senitectum* |
| Rice | Brown spot | *Bipolaris oryzae* |
| | False smut | *Ustilaginoidea virens* |
| | Blast of rice | *Pyricularia oryzae* |
| Maize | Leaf blight | *Bipolaris maydis* |
| | Downy mildew | *Peronosclerospora maydis* |
| | Loose smut | *Ustilago zeae* |
| Groundnut | Collor rot | *Macrophomina phaseolina* |
| | Seed rot | *Aspergillus flavus & niger* |
| Mustard | Downy mildew | *Peronospora parasitica* |
| | Pod spot | *Alternaria drassicae* |
| Sesame | Leaf blight | *Alternaria sesamicola* |
| | Sesame blight | *Corynespora cassiicola* |

# MATERIALS AND METHODS

Various microorganisms have been reported as causative agent of seed borne disease. Fungi and bacteria are most important pathogens among them. Scientists are able to discover methods to detect and identified. There are various techniques to detect the presence of pathogens associated with infection of seeds. Methods are described as follows:

*Collection of various oilseeds and cereal crops samples*
*Seed samples of Indo-gangetic areas*

For studying mycoflora associated with oilseeds (sesame, mustard, nut) and cereal crops (wheat, rice, maize) were collected from various region of Indo-gangetic area (Burdwan, Hooghly, Howrah; West Bengal, India).

*Seed samples of coastal zone*

For studying mycoflora associated with oilseeds (sesame, mustard, nut) and cereal crops (wheat, rice, maize) were collected from coastal zone of the Digha, West Bengal. The collected seed samples were shade dried and stored in paper bags at room temperature for further studies. All the seed samples were examined by visual seed inspections and occurrence of seed mycoflora was analyzed by standard blotter method and agar plate method.

*Surface sterilization of seed*

Surface sterilization of the seed was done by one percent sodium hypochlorite for 30 seconds. The seeds were then washed with three changes of sterile water.

*Detection of seed mycoflora*

For isolation of seed mycoflora associated with oilseeds the two detection methods viz. Standard Blotter Method and Agar Plate Method (ISTA 1996) were employed.

*Standard blotter method*

Three pieces of filter paper (Lantos *et al*. 2002, Agarwal 1976), were properly soaked in sterilized water and were placed at the bottom of a 9 cm well labelled plastic Petri dishes. Twenty (20) seeds per Petri dish were placed using a pair of forceps and making sure that seeds are placed equidistantly under aseptic conditions. The lids of each Petri dish were held in place with gummy cello tape. The Petri

dishes containing seeds were incubated at room temperature (25°± 2°C) for 7 days under alternating cycles of light and darkness of 12 hours each.

Fig 1 Standard Blotter Method

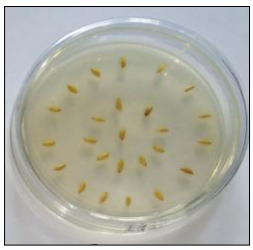

Fig 2 Agar plate method

*Agar plate method*

PDA was prepared and sterilized in an autoclave. In agar plate method (Barnet and Hunter 1999), 20 ml of potato dextrose agar was distributed to each of the sterile Petri plates under aseptic conditions. After cooling, crop seed samples were transferred (ISTA 2005) to the plate containing PDA medium. Twenty seeds per Petri plate were kept at equidistance in a circle and incubated at room temperature (25 ± 2 degree C) under 12 hours alternating cycles of light and darkness for 7 days and observed everyday for the growth of fungi (Warham 1990). The per cent seed mycoflora and percentage frequency of various fungal species were calculated. The incidence of fungi on seed performed under these methods were calculated as follows:

$$\text{Percent incidence} = \frac{\text{Number of infected seeds}}{\text{Number of plated seeds}} \times 100$$

*Identification of seed mycoflora*

The identification of fungi was done based on the morphological and colony characteristic of the pathogens. Ten fungi were noticed on the oilseed samples and cereal crop seed samples collected from the different region of Indo-gangetic and coastal zone of West Bengal. *Aspergillus niger, Aspergillus flavus* often appeared in many samples along with species of *Rhizopus sp.*, *Fusarium sp.* and *Mucor sp. Alternaria sp.* were found mostly in the seed samples. Spore morphology and colony characteristic are as under:

*Aspergillus niger*

Colony of *Aspergillus niger* on seed grows slowly, consisting of a compact to fairy loose white to faintly yellow basal mycelium, which bears abundant erect and initially crowed conidial structures. Conidial heads are typically large and black, compact at first, spherical or split into two or looser to reasonably well defined columns. Conidiophores are smooth, hyaline or faintly brownish near the apex. Two series conidia bearing the cells (supporting cells and phialides) are produced but in some heads only phialides are present. Conidia are typically spherical at maturity. Often very rough or spiny, mostly 4-5 µm diameter and very dark in colour or with conspicuous longitudinal striations.

*Aspergillus flavus*

Colony of *Aspergillus flavus* on seed is usually spreading and very light. Yellow to deep yellow-green, olive-brown. Conidiophores are swollen apically with numerous conidia bearing cells in long chains. Conidiophores are heavily walled, hyaline coarsely and rough end. They can be one or two series of conidia bearing cells (Phialides and supporting cells). Conidia are typically spherical to sub-spherical, conspicuously spiny, variably 3-6 µm in diameter.

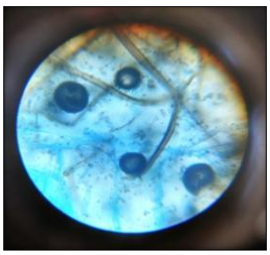

Fig 3 *Aspergillus sp.*

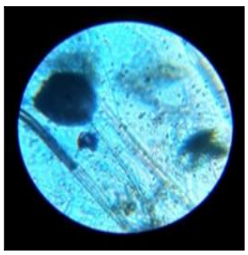

Fig 4 *Mucor sp.*

*Mucor sp.*

Colonies grow rapidly at the temperature of 25-30°C. It resembles cotton candy. From the front the colour is white initially and becomes greyish brown. Conidia are generally globose to ellipsoidal, yellowish brown and slightly rough-walled and are produced in sporangia that are developed around pin form columella. Mycelium are generally shiny, hyaline, greyish white to milky white. Conidiophore are Pin form columella and are found which bears the sporangia around it.

*Rhizopus sp.*

Colony of *Rhizopus sp.* on seed grows slowly, consisting of a compact to fairy loose pink mycelium, sporangiophores grow in cluster they are stout and stiff, the characteristic features is rhizoids present at the base of the sporangium, vegetative body is highly branched coenocytic in nature. The sporangium contain either one or both type of sporangiospore.

Fig 5 *Rhizopus sp.*

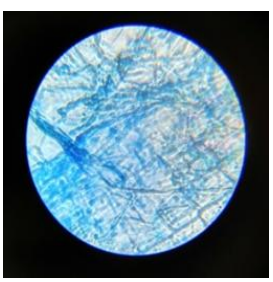

Fig 6 *Penicillium sp.*

*Penicillium sp.*

*Penicillium spp.* are commonly known as contaminants. The colonies of *Penicillium sp.* are rapid growing, flat, filamentous and velvety, woolly or cottony in structure. The colonies are initially white and become blue green, gray green, olive gray, yellow or pinkish in time. Colonies of *Penicillium sp.* are often dominated by copious clear to

yellow or brown exudates at the centres. Hyphae are septate, hyaline measuring 1.5 to 5 µm in diameter with simple or branched conidiophores. Metulae are secondary branches that form on conidiophores. The metulae carries the flasks shaped phialides. The organisation of the phialides and the conidiophores are very typical. They form brush like clusters, which are also referred as "penicilli". The conidia (2.5–5 µm in diameter) are round, unicellular and visualized as unbranching chains at the tip of phialides.

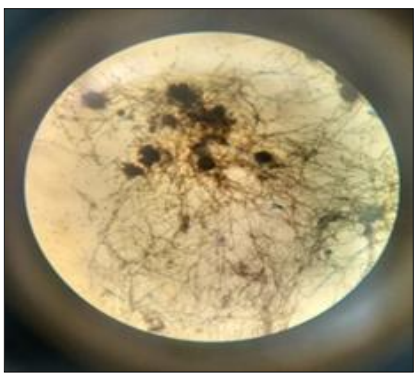

Fig 7 *Macrophomina sp.*

*Macrophomina sp.*

Conidia are aseptate, hyaline, ellipsoidal to obovoid. Pycnidia are larger than sclerotia, dark brown to black and scattered throughout the surface. Hyphae are thick, grey to brown to black or dull white to light brown. Produces a profuse aerial mycelium with pycnidia and sclerotia. Sclerotia are black, shiny, and irregular shaped. Pycnidia are larger than sclerotia, dark brown to black and scattered throughout the surface.

## RESULTS AND DISCUSSION

The results of *in-vitro* studies conducted at the Department of microbiology; Rabindra Maha Vidyalaya; Champadanga; Hooghly,West Bengal, India during 2018.

*Germination percentage of oil seeds of Indo-gangetic and coastal areas under in-vitro condition*

The data obtained from (Table 1) indicated that the germination percentage of sesame (black) and nut were respectively 64% and 72%.

Table 1 Germination percentage of different oil seeds of coastal area under *in-vitro* condition (Agar Plate Method)

| Oil seeds | Germination percentage (%) |
|---|---|
| Sesame (black) | 64.00 |
| Nut | 72.00 |

Table 2 Germination percentage of different oil seeds of indo-gangetic area under *in-vitro* condition (Agar Plate Method)

| Oil seeds | Germination percentage (%) |
|---|---|
| Sesame (black) | 92.00 |
| Nut | 96.00 |

The data obtained from (Table 2) indicated that the germination percentage of sesame (black) and nut were respectively 92% and 96%.

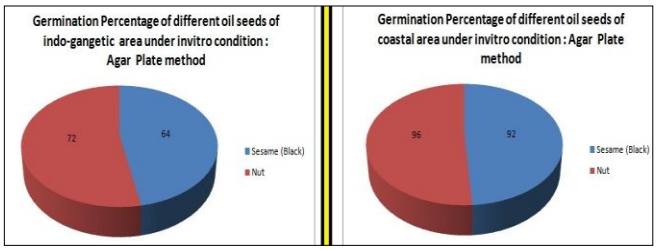


Fig 8 Comparing germination rate different oil seeds between Indo-gangetic seed and coastal area seed

*Fungal growth of oil seeds of Indo-gangetic and coastal areas under in-vitro condition*

The data obtained from (Table 3) indicated that the fungal growth of sesame (black) and nut were respectively 50% and 45%.

Table 3 Fungal growth of different oil seeds of Indo-gangetic area under in-vitro condition (Agar Plate Method)

| Oil seeds | Fungal growth |
|---|---|
| Sesame (black) | 35.00 |
| Nut | 20.00 |

Table 4 Fungal growth of different oil seeds of coastal area under *in-vitro* condition (Agar Plate Method)

| Oil seeds | Fungal growth |
|---|---|
| Sesame (black) | 50.00 |
| Nut | 45.00 |

The data obtained from (Table 4) indicated that the fungal growth of sesame (black) and nut were respectively 35% and 20%.

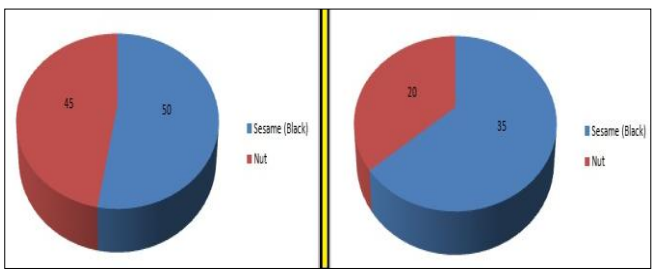


Fig 9 Comparing fungal growth of different oil seeds of Indo-gangetic area and coastal area under in-vitro condition

Table 5 Germination percentage of different cereal crop seeds of coastal area under *in-vitro* condition

| Cereal crop seeds | Germination percentage |
|---|---|
| Protiksha | 60.00 |
| Swarna | 68.00 |
| Khas | 56.00 |
| Minikit | 72.00 |
| Kalma | 52.00 |

*Germination percentage of cereal crops of Indo-gangetic and Coastal areas under in-vitro condition*

The data obtained from (Table 7) indicated that the germination percentage of Pratiksha, Swarna, Khash, Minikit, Kalma were respectively 60%, 68%, 56%, 72% and 52%.

Table 6 Germination percentage of different oil seeds of indo-gangetic area under *in-vitro* condition

| Cereal crop seeds | Germination percentage |
|---|---|
| Pratiksha | 88.00 |
| Swarna | 92.00 |
| Khas | 84.00 |
| Minikit | 96.00 |
| Kalma | 80.00 |

The data obtained from (Table 8) indicated that the germination percentage of Pratiksha, Swarna, Khash, Minikit, Kalma were respectively 88%, 92%, 84%, 96% and 80%.

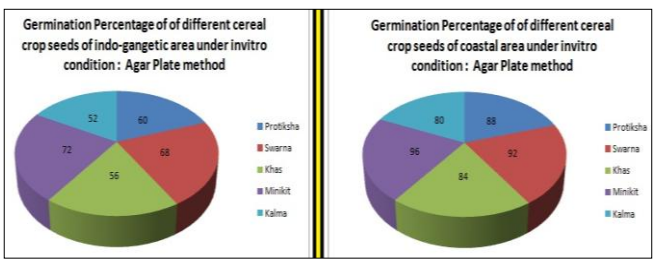


Fig 10 Comparing germination percentage between cereal crop seeds of Indo-gangetic area and coastal area

*Fungal growth of cereal crops of Indo-gangetic and coastal areas under in-vitro condition*

Table 7 Fungal growth of different oil seeds of Coastal area under *in-vitro* condition

| Cereal crop seeds | Fungal growth |
|---|---|
| Pratiksha | 38.00 |
| Swarna | 35.00 |
| Khas | 40.00 |
| Minikit | 30.00 |
| Kalma | 44.00 |

Table 8 Fungal growth of different oil seeds of indo-gangetic area under *in-vitro* condition

| Cereal crop seeds | Fungal growth |
|---|---|
| Pratiksha | 20.00 |
| Swarna | 18.00 |
| Khas | 25.00 |
| Minikit | 15.00 |
| Kalma | 28.00 |

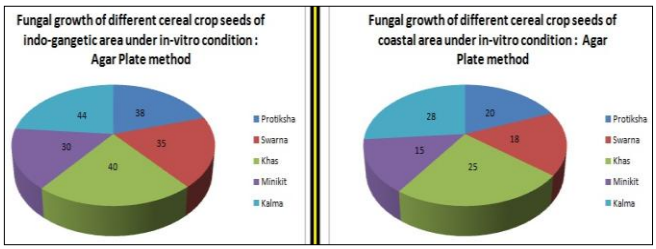


Fig 11 Comparing fungal growth between cereal crop seeds of Indo-gangetic and coastal area

The data obtained from (Table 10) indicated that the fungal growth of Pratiksha, Swarna, Khash, Minikit, Kalma were respectively 38%, 35%, 40%, 30% and 44%.

The data obtained from (Table 11) indicated that the fungal growth of Pratiksha, Swarna, Khash, Minikit, Kalma were respectively 20%, 18%, 25%, 15% and 28%.

*Evaluation of plant extract under in-vitro condition*

Various plant extracts such as leaf extract of Neem, Tulsi, Bisalyakarani, Thankuni, Basak, Sajne, Bon tulsi, Garlic, Ginger, Datura, Nilgiri have been used for seed treatment of different varieties of oilseeds and cereal crops by soaking methods. Extract of botanicals has been applied at two concentrations, 500ppm and 1000 ppm made. Fresh plant materials are collected and washed first in tap water and then three times in distilled water. The botanical samples was chopped and then crushed in a surface sterilized mortar and pestle by adding 100 ml of sterile distilled water (1:1 w/v). The phyto- extracts are filtered with double layered muslin cloth and filtrate is used as stock solution. Seeds were dipped in plant extract for one hour and then kept in sterilized moist chamber of plastic petriplates for seven days incubation. Observation regarding seed germination and mycoflora associated with seed have been recorded in percentage.

*Evaluation of plant extract on basis of fungal growth of cereal crop seeds of Indo-gangetic areas under in-vitro condition*

Table 9 Evaluation of plant extract on basis of fungal growth of cereal crop seeds of Indo-gangetic areas

| Cereal crops | Plant extracts | | | | | | | | | | | | | | | | | | | | Control |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tulsi | | Bisalyakarani | | Neem | | Thankuni | | Basak | | Sajne | | Garlic | | Ginger | | Datura | | Nilgiri | | |
| | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | |
| Pratiksha | 75 | 80 | 90 | 96 | 50 | 60 | 35 | 46 | 85 | 96 | 40 | 47 | 40 | 44 | 45 | 50 | 40 | 48 | 81 | 89 | 30 |
| Swarna | 70 | 74 | 89 | 94 | 55 | 63 | 45 | 50 | 88 | 94 | 50 | 56 | 32 | 40 | 50 | 59 | 50 | 57 | 50 | 60 | 29 |
| Khas | 55 | 62 | 75 | 87 | 50 | 62 | 55 | 64 | 86 | 91 | 30 | 43 | 40 | 47 | 35 | 40 | 37 | 45 | 31 | 40 | 27 |
| Minikit | 60 | 67 | 80 | 90 | 36 | 44 | 30 | 40 | 70 | 78 | 33 | 45 | 45 | 56 | 37 | 43 | 30 | 45 | 50 | 60 | 25 |
| Kalma | 110 | 130 | 46 | 53 | 60 | 68 | 65 | 76 | 115 | 140 | 58 | 63 | 61 | 70 | 60 | 67 | 77 | 84 | 95 | 100 | 35 |

Table 10 Evaluation of plant extract on basis of fungal growth of cereal crop seeds of coastal areas

| Cereal crops | Plant extracts | | | | | | | | | | | | | | | | | | | | Control |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tulsi | | Bisalyakarani | | Neem | | Thankuni | | Basak | | Sajne | | Garlic | | Ginger | | Datura | | Nilgiri | | |
| | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | |
| Pratiksha | 55 | 60 | 70 | 76 | 30 | 35 | 20 | 28 | 60 | 67 | 23 | 33 | 20 | 30 | 25 | 30 | 20 | 28 | 60 | 66 | 17 |
| Swarna | 50 | 54 | 55 | 64 | 35 | 40 | 28 | 36 | 65 | 72 | 27 | 37 | 20 | 25 | 20 | 28 | 30 | 36 | 35 | 42 | 16 |
| Khas | 35 | 43 | 57 | 62 | 30 | 33 | 37 | 42 | 55 | 61 | 18 | 22 | 24 | 30 | 25 | 32 | 20 | 26 | 20 | 26 | 12 |
| Minikit | 39 | 45 | 40 | 50 | 20 | 27 | 19 | 26 | 50 | 55 | 27 | 33 | 30 | 35 | 28 | 37 | 20 | 28 | 30 | 34 | 15 |
| Kalma | 65 | 75 | 37 | 44 | 40 | 45 | 35 | 39 | 40 | 48 | 70 | 76 | 36 | 42 | 49 | 55 | 40 | 47 | 70 | 75 | 20 |

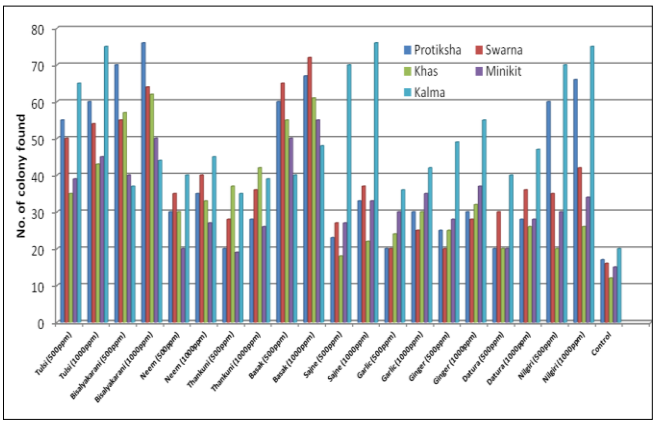


Fig 12 Evaluation of plant extract on the basis of fungal growth of different cereal crop seeds of indo-gangetic area under *in-vitro* condition : Agar Plate method

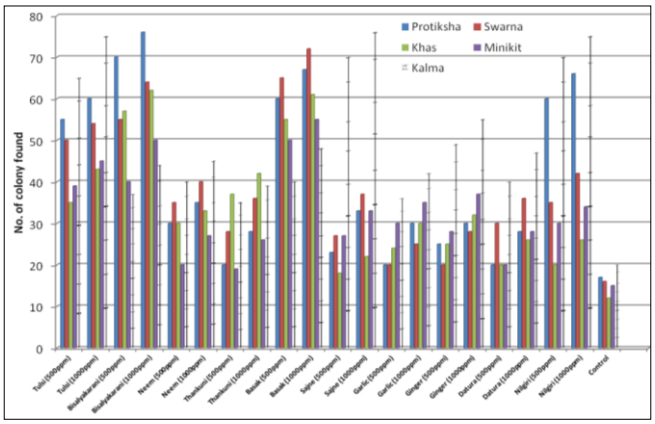


Fig 13 Evaluation of plant extract on the basis of fungal growth of different cereal crop seeds of coastal area under *in-vitro* condition : Agar Plate method

Table 11 Evaluation of plant extract on basis of fungal growth of oil seeds of Indo-gangetic areas

| Cereal crops | Plant extracts | | | | | | | | | | | | | | | | | | | | Control |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tulsi | | Bisalyakarani | | Neem | | Thankuni | | Basak | | Sajne | | Garlic | | Ginger | | Datura | | Nilgiri | | |
| | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | |
| Sesame (black) | 75 | 85 | 96 | 100 | 76 | 86 | 24 | 30 | 45 | 50 | 37 | 42 | 65 | 70 | 70 | 75 | 86 | 90 | 40 | 50 | 27 |
| Nut | 55 | 64 | 65 | 70 | 80 | 86 | 70 | 80 | 47 | 57 | 45 | 50 | 65 | 69 | 68 | 77 | 65 | 70 | 75 | 79 | 35 |

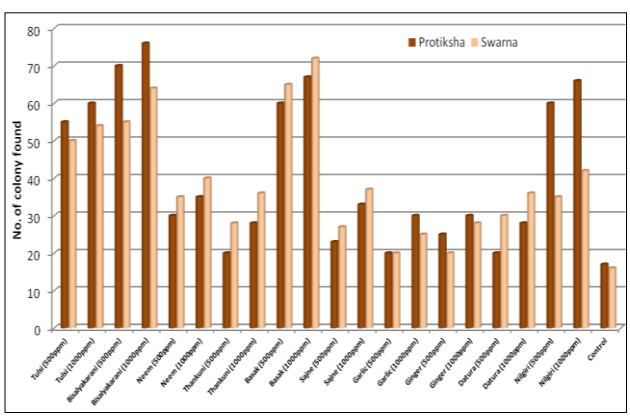


Fig 14 Evaluation of plant extract on the basis of fungal growth of different oil seeds of Indo-gangetic area under *in-vitro* condition : Agar plate method

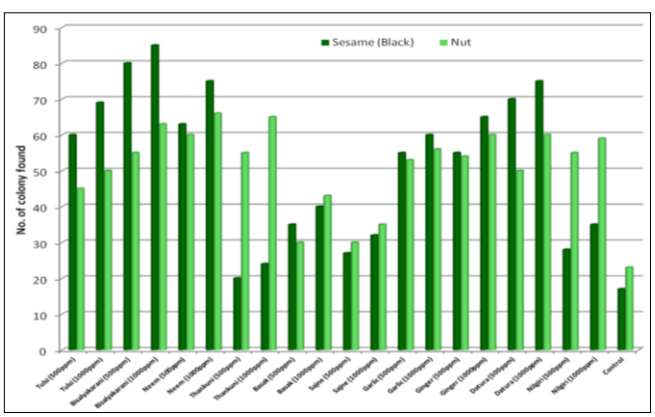


Fig 15 Evaluation of plant extract on the basis of fungal growth of different oil seeds of coastal area under *in-vitro* condition : Agar Plate method

This present work deals with the comparative study of fungal growth and germination percentage of different oil and cereal crop seed of coastal area and Indo-gangetic area. It was found that the rate of germination of indo-gangetic areas seeds were more than the rate of germination of Coastal zones seeds. Whereas the fungal community were appeared more frequently and distractive in Coastal region. Environmental factors are the most decisive factor for

growth of fungal species. In case of coastal area the temperature range is 25°-30° and the relative humidity is 50-79%. All the environmental factors of coastal area were found more suitable for the growth of microflora than indo-gangetic region. Wind speed and sunshine hours have a positive effect on the growth of microflora. The wind speed of coastal region range from 11-15 KpH, which were found most appropriate for faster multiplication and spread of the pathogen. All the meteorological factors were responsible for the development of the disease of coastal regions seeds and thus their germination percentages were decreases. Among 10 plant extracts of Bisalyakaruni, Neem, Basak and tulsi showed more efficient result than others. Whereas in case of coastal and indo-gangetic regions seeds. Thus these 4 plant extracts can be used as biofertilizer and biostimulants to treat both indo-gangetic and coastal regions seed crops. Biostimulants are product that reduces the need for fertilizers and increase plant growth. The above mentioned information are very useful for the farmers involved in oil and cereal crop cultivation. They also can take their decision in time of sowing of crop and enhance their profitability by proper management of disease. Here more research work is required to detect, identify, isolate those bacterial and fungal pathogens. Institutions have to cooperate with researchers and scientists to carry on this type of research work. From present review we can identify and control seed-borne pathogenic fungi and still now science is unable to identify those pathogenic microorganisms like bacteria, virus etc. So more research work is needed to detect and control them. If we can detect them, then it will be easier to decrease infections caused by them.

Table 12 Evaluation of plant extract on basis of fungal growth of oil seeds of coastal areas

| Cereal crops | Plant extracts | | | | | | | | | | | | | | | | | | | | Control |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Tulsi | | Bisalyakarani | | Neem | | Thankuni | | Basak | | Sajne | | Garlic | | Ginger | | Datura | | Nilgiri | | |
| | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | 500 ppm | 1000 ppm | |
| Sesame (black) | 60 | 69 | 80 | 85 | 63 | 75 | 20 | 24 | 35 | 40 | 27 | 32 | 55 | 60 | 55 | 65 | 70 | 75 | 28 | 35 | 17 |
| Nut | 45 | 50 | 55 | 63 | 60 | 66 | 55 | 65 | 30 | 43 | 30 | 35 | 53 | 56 | 54 | 60 | 50 | 60 | 55 | 59 | 23 |

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# Microbial Biodegradation of Plastic: A Noble Approach

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Review Article

# Microbial Biodegradation of Plastic: A Noble Approach

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## Abstract

Plastic assume a significant part in economy all around the world broad use in farming, building and development and wellbeing and buyer merchandise. Usually involved strategies for plastic removal were ended up being lacking for compelling plastic waste administration, and subsequently there is developing worry for utilization of proficient microorganisms implied for biodegradation of non-degradable manufactured polymer. The biodegradable polymers are intended to debase quick by microorganisms due their capacity to corrupt the majority of the natural and inorganic materials, including lignin, starch, cellulose and hemicelluloses. Plastics aggregation ashore and ocean has stimulated interest to corrupt these polymers. That is a necessary to involve satisfactory biodegradable strategies to decrease plastics trouble from the climate. To defeat plastics related ecological issues, comprehension of the communication among organisms and polymers is of prime significance. Many living organic entities yet overwhelmingly microorganisms have advanced systems to get by and corrupt plastics. The current survey centers around the kinds of plastics based on warm and biodegradable in nature, corruption and types of biodegradation, sorts of plastics which are degradable, portrayal of biodegradation , and variables influencing biodegration. Plastic corruption and bioremediation potential make these microorganisms auspicious for green science to take out destructive plastics from the biological system.

The current survey examines the ongoing status, components of biodegradation of plastics, methods for describing corrupted plastics and elements influencing their biodegradation.

**Keywords:** Plastic; Degradation; Microorganisms; Polymer

## Introduction

From various types of hydrocarbons and petrol subsidiaries high atomic weight natural polymers are gotten. These polymers are known as plastic [23] "Plastic" came from the Greek word "Plastikos", that implies which can be formed into various shapes. Plastics expressed as the polymers what begin continuing on warming that's why it can be casted into molds [17]. For the most part, plastic materials are gotten from petrochemicals with the exception of biodegradable bioplastic. Plastic comprises of chloride, oxygen, hydrogen, carbon, silicon and nitrogen. Polyethylene comprises of 64% of absolute plastic and its overall recipe is CnH2n [17].

For bundling and numerous different purposes like agrarian movies arrangement, diaper bundling and fishing nets plastics are utilized. Plastics have a significant impact in each area of economy from one side of the planet to the other. In exceptionally developing regions for example horticulture, building and development, wellbeing and shopper merchandise, use of plastics guarantees that they are popular and without nobody can take care of business. Plastics, the foundation of numerous enterprises, are utilized in assembling of different items that are utilized in our day to day routine for example safeguard materials, sterile products, tiles, plastic jugs, fake cowhide and different other family things. Plastics are likewise utilized in bundling of food things, drugs, cleansers and beauty care products [3].

One of the quickly developing fields in worldwide industry is the creation of engineered plastics. Plastics are more better than different materials due than their special characteristics. These characteristics have been directed to build the plastic creation scale to 20 folds starting around 1964 (Ellen MacArthur Establishment 2016), and creation scale surpasses 300 million tons/year (Plastics Europe 2015) in 2015 it came to 335 million tons (Plastics Europe 2017). There are benefits and weaknesses of plastics. Plastics are solid, strong, and light weight. Then again, they are hurtful to the common habitat, impervious to debasement and prompting ecological contamination. On our earth, plastics represent a serious danger by collecting in enormous amounts [43]. Plastics can be separated into degradable and non- degradable polymers based on their substance properties. Plastics that are acquired from sus-

tainable assets are biodegradable plastics. These are normally degradable, as a wellspring of cellulose, starch and algal material, a significant part in plants, creatures and green growth. These polymers are additionally created by microorganisms. Non-degradable plastics, commonly known as engineered plastics, are gotten from petrochemicals and are higher in atomic load because of the reiterations of little monomer units [23].

During plastic debasement the age of plastic particles with a size of < 5 mm are known as microplastics (MPs) which lead to potential ecotoxicological impacts. Sinewy MPs might be breathed in, may endure in the lung , and alongside related impurities including colors and plasticizers could prompt wellbeing impacts like cancer-causing nature and mutagenicity [17]. For the most part, it is acknowledged that plastic waste can for all time be dispensed with through cremation. Notwithstanding, unburned material actually exists in the base debris as a strong build up from incinerators that can deliver 360 to 102,000 microplastic particles for each metric ton after cremation. This base debris is a possible wellspring of microplastics delivered into the climate [1]. It is accounted for that plastic sections in the <100nm size range, alluded to as nanoplastics (NPs), may likewise be framed in the oceanic climate and may cause potential wellbeing impact [33].

## Different types of non-biodegradable plastics

### Polyethylen

Polyethylene (PE), otherwise called polyethene (IUPAC name) or polythene, is a significant gathering of thermoplastic polymers, delivered by the polymerization of ethylene. Contingent upon the polymerization interaction utilized, different sorts of polyethylene with contrasting properties can be gotten. They are arranged in light of their thickness, atomic weight, and stretching structure. For example, high thickness polyethylene (HDPE) is utilized for items, for example, milk containers, cleanser bottles, margarine tubs, trash bins, and water pipes. Ultra high atomic weight polyethylene (UHMWPE) is utilized in can-and bottle-dealing with machine parts, course, cog wheels, joints, and butchers' hacking sheets, and may try and be tracked down in tactical armour carriers. Low thickness polyethylene (LDPE) is utilized for the creation of inflexible compartments and plastic film. Starting around 2017, north of 100 million tons of polyethylene pitches are being delivered every year , representing 34% of the complete plastics market.

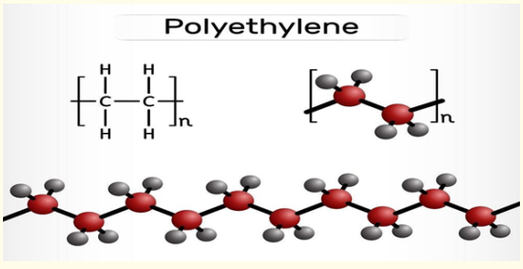


**Figure 1**

| Name of bacteria | %Weight loss/month | Reference |
|---|---|---|
| *Pseudomonas* sp. | 20.54 ± 0.13 | [53] |
| *Staphylococcus* sp. | 16.39 ± 0.01 | [53] |
| *Moraxella* sp. | 7.75 ± 0.61 | [53] |
| *Micrococcus* sp. | 6.61 ± 0.42 | [53] |
| *Streptococcus* sp. | 2.19 ± 0.15 | [53] |

**Table 1:** Biodegration of polyethylene by bacteria.

### Polypropylene

Polypropylene, a manufactured pitch developed by the polymerization of propylene. One of the significant group of polyolefin tars, polypropylene is shaped or expelled into numerous plastic items where strength, adaptability, light weight, and intensity opposition are required. It is additionally turned into strands for work in modern and family materials. Propylene can likewise be polymerized with ethylene to create a versatile ethylene-propylene copolymer. PP (CnH2n) is the most broadly involved plastic in the auto business. Be that as it may, its spines, involving high atomic weight (10k-40k g/mol), long carbon chains and added stabilizers and cell reinforcements during blend, keep PP from barometrical oxidation [5]. The organism *Aspergillus niger* and microbes in the genera Vibrio and Pseudomonas have been accounted for to debase PP. Pretreated PP has likewise been utilized to direct debasement studies. UV-light, warm therapy, and gamma-illumination pretreatment strategies have been performed to make PP more powerless to debasement, as these pretreatment procedures diminish the hydrophilicity of PP. Additionally, UV-pretreated PP is biodegradable by the Bacillus flexus microorganism [28]. In any case, biodegradation of PP can undoubtedly be improved by mixing it with cellulose or starch mix; sugar mixes give the attachment of microorganisms to the PP surface.

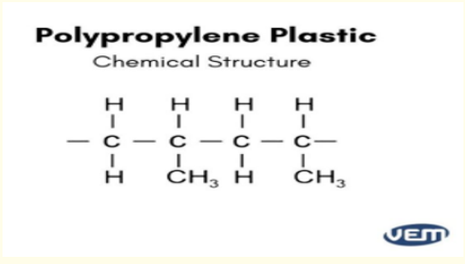


**Figure 2**

| Name of bacteria | % weight loss/ month | Reference |
|---|---|---|
| *Pseudomonas* sp. | 9% | [15] |
| *Aneurinbacillus* sp. and *Brevibacillus* sp | 56% | [15] |
| *Bacillus* sp. and *Rhodococcus* sp. | 6% | [15] |

**Table 2:** Biodegration of polypropylene by bacteria.

## Polystyrene

Polystyrene is an inflexible, solid tar that is incredibly straightforward. It is the most widely utilized plastic and is produced using the polymerization of styrene. The thermoplastic polymer is a strong at encompassing temperature, however it streams when warmed over 100 °C. Polystyrene is water-insoluble. With a couple of exemptions, polystyrene is a non-biodegradable material. Numerous sweet-smelling hydrocarbon solvents and chlorinated solvents disintegrate it rapidly. It's normally used in the foodservice business as unbending plate, holders, dispensable eating plates, and bowls, among other things. Polystyrene is a polymer of styrene. It is an engineered sweet-smelling hydrocarbon. It is hydrophobic in nature. Its IUPAC name is poly(1-phenylethane-1,2-diyl). Its overall recipe is (C8H8)n. PS squanders result from boundless business utilization of extended PS (EPS), otherwise called Styrofoam, in building protection and pressing, and of expelled PS (XPS) in holders, for example, espresso cups and food plate. The special design of PS, with its direct carbon spine and exchanging spine iotas joined to phenyl moieties, makes its biodegradation truly challenging. Consequently, debasing PS has turned into a basic worldwide issue. The biodegradation of polystyrene by Tenebrio molitor was explored by reproducing and raising the mealworms in the presence and nonappearance of polystyrene. An examination was made between those took care of with a typical eating routine and those benefited from polystyrene. The mealworms which were taken care of with polystyrene were then analyzed and the guts were gathered to confine and recognize the microscopic organisms in their guts. The reduction in mass of the polystyrene as feedstock affirmed that the mealworms were relying upon polystyrene as their only carbon diet. The frass egested by mealworms likewise affirmed the biodegradation of polystyrene as it contained exceptionally minuscule build-ups of polystyrene. Three detaches were acquired from the mealworms guts, and all were viewed as gram-negative. The sequencing results showed that the disconnects were *Klebsiella oxytoca* ATCC 13182, *Klebsiella oxytoca* NBRC 102593 and *Klebsiella oxytoca* JCM 1665.

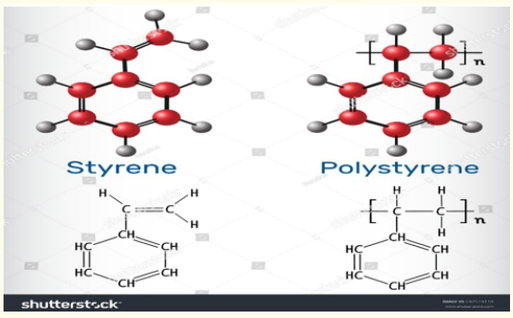


**Figure 3**

| Name of bacteria | % weight loss/ month | Reference |
|---|---|---|
| *Bacillus paralicheniformis* | 34% | [50] |
| *Pseudomonas lini* | - | [50] |
| *Acinetobacter johnsoni* | - | [50] |

**Table 3:** Biodegration of polystyrene by bacteria.

## Polyethylene terephthalate

PET is delivered by the polymerization of ethylene glycol and terephthalic corrosive. Ethylene glycol is a dismal fluid gotten from ethylene, and terephthalic corrosive is a glasslike strong gotten from xylene. At the point when warmed together affected by synthetic impetuses, ethylene glycol and terephthalic corrosive produce PET as a liquid, thick mass that can be turned straightforwardly to filaments or cemented for later handling as a plastic. In compound terms, ethylene glycol is a diol, a liquor with a sub-atomic construction that contains two hydroxyl (Goodness) gatherings, and terephthalic corrosive is a dicarboxylic fragrant corrosive. At a somewhat higher sub-atomic weight, PET is made into a high-strength plastic that can be molded by every one of the normal techniques utilized with different thermoplastics. PET movies (frequently sold under the brand names Mylar and Melinex) are created by expulsion. Liquid PET can be blow-formed into straightforward holders of high strength and inflexibility that are likewise essentially impermeable to gas and fluid. Here, PET has become broadly utilized in carbonated-refreshment bottles and in containers for food handled at low temperatures. The low relaxing temperature of PET — roughly 70 °C (160 °F) — keeps it from being utilized as a holder for hot food sources. PET is the most broadly reused plastic. In the US, notwithstanding, around 20% of PET material is reused. PET jugs and holders are normally broken down and turned into strands for fibrefill or floor coverings. At the point when gathered in a reasonably unadulterated state, PET can be reused into its unique purposes, and techniques have been contrived for separating the polymer into its compound antecedents for resynthesizing into PET. Among the distributions that pre-owned wild-type PET-corrupting microorganisms, 56.3% utilized microbes [54] 32.4% involved organisms [44], 7.0% both (microorganisms and growths) (Avendaño Toledo CA, Castro Velazco AM (2020) Determination of the most effective pretreatment on polyethylene terephthalate to increase the efficiency of the degradation process carried out by fungi and native microbes from landfill leachate. Universidad Libre, Socorro Santander), 1.4% utilized microalgae [27]. Among the microorganisms, Bacillus sp. Was the most successive sort [54].

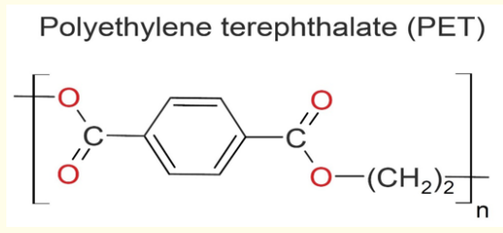


**Figure 4**

| Name of bacteria | % weight loss/ month | Reference |
|---|---|---|
| *Bacillus subtilis* | 56.3% | Int J Recent Adv Multidiscip., *et al*. 2015 |
| *Pseudomonas aeruginosa* | 3.62 ± 0.32% | [54] |
| *Priestia aryabhattai* | 40% | [54] |

**Table 4:** Biodegration of polyethylene terephthalate by bacteria.

## Mechanism of biodegration of plastic by microorganisms

The mechanism of biodegradation by bacteria involves several processes that allow bacteria to break down complex organic compounds into simpler, more manageable forms. Bacteria have evolved various strategies to degrade different types of organic matter, including pollutants, plant materials, and animal waste. Here's a general overview of the mechanisms involved.

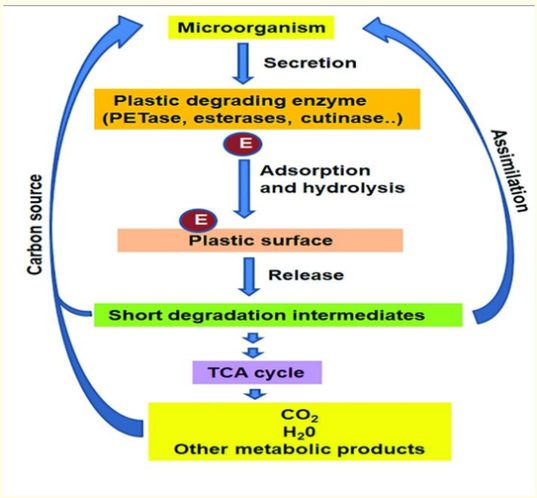


**Figure 5:** Mechanism of biodegration of plastic by microorganisms.

Bacteria produce and release a wide array of enzymes into their surrounding environment. These enzymes, such as proteases, lipases, cellulases, and ligninases, are specific to different types of organic compounds and help break them down into smaller components. Bacteria possess mechanisms to recognize and adhere to the target substrate. This can involve specialized surface structures or appendages that allow the bacteria to attach to the organic material, providing direct access to the nutrients. Once attached to the substrate, bacteria secrete enzymes that degrade the complex organic compounds into simpler molecules. For example, cellulases break down cellulose, a complex carbohydrate found in plant cell walls, into glucose units. These simpler molecules are more easily metabolized by the bacteria. Bacteria have metabolic pathways that allow them to utilize the breakdown products generated by the enzymes. The simpler molecules are taken up by the bacterial cells and undergo further metabolism to produce energy and essential building blocks for growth and reproduction. In some cases, biodegradation involves a consortium of bacteria working together. Different bacterial species may have complementary enzymes or metabolic pathways, enabling them to break down complex compounds more efficiently as a team. Some bacteria possess the ability to detoxify harmful substances during the biodegradation process. They can transform or degrade toxic compounds into less harmful forms, reducing the environmental impact of pollutants.

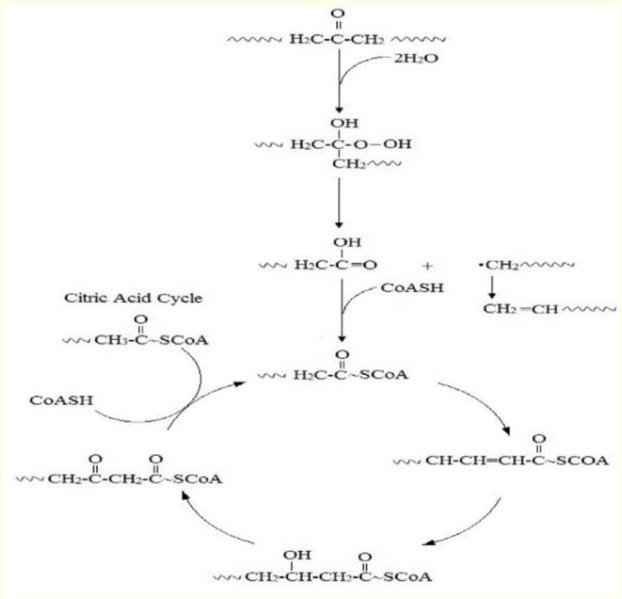


**Figure 6:** Mechanism for the biodegration of polyethylene.

It's important to note that different bacteria have specific capabilities and preferences for degrading different substances. Their effectiveness in biodegradation depends on their genetic makeup, environmental conditions, availability of necessary nutrients, and other factors. Scientists and engineers often leverage these natural abilities of bacteria for bioremediation purposes to clean up contaminated environments or for the treatment of wastewater and industrial waste.

## Conclusion

Plastics are petrol inferred polymers and are utilized for different purposes. PE sacks are utilized all around the world at large levels. The accessibility of miniature and nanoplastics in oceanic climate has been expanded many folds because of biodegradation, thermooxidative corruption, photodegradation, warm and hydrolysis processes in the environment and postures serious danger to the amphibian life (new and marine) and human existence through food web. There is a need to utilize sufficient biodegradable strategies to destroy these polymers from the environment. Because of the hydrophobic and inactive nature, it is challenging to eliminate or debase polymers. Other than physical and substance techniques, microorganisms have shown promising potential to debase these polymers. The likely utilization of organisms for polymers expulsion should be additionally assessed utilizing unique polymers

sullied wastewater. The evacuation of microplastics/nanoplastics, their poisonousness and the usage of organisms still need to be tended to. The exchange of plastic polymers from the loss into the sea-going environment including streams and seas through various cycles and the methodology to move these polymers from the wastewater to a reasonable spot for statement/burning ought to appropriately be supported. Long haul composed cleanup activities are expected to assess the dynamic biological system impacts.

## Future Prospect

White contamination, because of plastic waste amassing, is of major ecological concern, these days. The issue of polymers' biodegradation lies in their own temperament that obstructs the polymer breakdown into monomers. Truth be told, the microbial catalyst frameworks are pointless against non-hydrolyzable engineered polymers. The event and movement of polymer-corrupting microorganisms differ as per the predominant natural circumstances.

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# Comprehensive Studies of Black Pepper and its Chemical Profiling

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## Research Article

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***For Correspondence**

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**Keywords:** Pharmacological, Natural, Flavonoids, inhibition.

**ABSTRACT**

In a traditional systems use of medicinal plants have a great role. Medicinal plants have diverse pharmacological potential with very lesser or no side effect. Black pepper (*Piper niger* L.) is a natural medicinal plant used to treat many diseases. Here we have used ethanol, chloroform, and methanol extract of Black pepper of 50µg/ml, 100µg/ml, 200µg/ml, and 300µg/ml concentration. It is observed that 300µg/ml concentration of ethanol extract of Black pepper shows the high zone of inhibition. There are several phytochemical, found in Black pepper after observing in qualitative phytochemicals analysis. The phytochemicals are alkaloids, flavonoids, steroids, tannins, and saponins.

## INTRODUCTION

The Plants have antimicrobial, antiviral, and antibacterial potential. Day by day the search on antimicrobial activities of plants increases with high expectation. Black pepper is a type of spice, scientific name Piper nigram, found in almost all over the world having various medicinal activities. A fresh mature Black pepper of approximately 5m in diameter contains a seed like a drupe. Black pepper is mainly cultivated in tropical regions, Vietnam is the world's largest source of Black pepper. It can maintain cholesterol levels, blood sugar, gut breath and can improve the brain. Here I have studied the antimicrobial effect of Black pepper.

## MATERIAL AND METHODS

**Collection of Plant Material:**

Seed of Black Pepper was selected for the study of antibacterial activity and phytochemical analysis. The seed black pepper was collected from the market on Hooghly, West Bengal, India.

**Taxonomical position of Black pepper:-**

Kingdom: Plantae

Clade: Tracheophtyes

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long Clade: Angiosperms

Clade: Mangnoliids

Order: Piperales

Family: *Piperaceae*

Genus: Piper

Species: *P. nigrum*

Fig 1: Black papper

**Bacterial cultures:**

To study the antibacterial effect here used Staphylococcus aureus as Gram-positive bacteria, Escherichia coli, and Salmonella typhi as Gram-negative bacteria.

**Preparation of different extraction:**

- **Ethanol extract:** 10 g of powdered plant material was dissolved into enough ethanol to make 40 ml of ethanolic extract (25% w/v). The procedure to make extract was same as procedure used for aqueous extract.
- **Chloroform extract:** 5gm of air-dried powder of leaves was mixed with 25ml of chloroform in a conical flask and then kept on a rotary shaker for 10mints. Then they were bound with tissue paper and a rubber band. Some holes were made so that air can pass through it and then kept in room temperature for 3-5 days for evaporating.
- **Methanol extract:** 5gm of air-dried powder of leaves was mixed with 25ml of methanol in a conical flask and then kept on a rotary shaker for 10mints. Then they were bound with tissue paper and a rubber band. Some holes were made so that air can pass through it and then take room temperature for 3-5 days for evaporating.

**Preparation of extract concentration:**

Four concentrations (50mg/ml, 100mg/ml, 200mg/ml and 300mg/ml) were made from each of the three extracts (Chloroform, Ethanol, Methanol extract). In every case, 3 gm of Extract was mixed with 10ml DMSO (Dimethyl Sulfoxide) to prepare 300 mg/ml stock concentration..

**Microbiological assay:**

- **Agar disc diffusion method:** The antibacterial screening of seed extract of black pepper was prepared by dissolving 3gm of each extract separately in 10ml Dimethyl Sulphoxide (DMSO). From this 50µg/ml, 100µg/ml, 200µg/ml, 300µg/ml concentration were taken for the analysis of antibacterial activity. A hollow tube was heated and pressed above the inoculated agar plate. It was removed immediately by making a well in the plate; two wells on each plate were made one each for DMSO control.

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- **Disc diffusion method:** A single colony of the purified isolates was inoculated in 5 ml sterile peptone water and incubated at 37°C overnight. Thereafter, a loop full culture was diluted in 5 ml sterile phosphate-buffered saline and seeded into Muller Hinton agar. The antibiotic disc (Hi-Media) was placed on the surface of the agar and incubated overnight at 37°C. The zone of inhibition was recorded and a control sensitive culture was included in the experiment.

**Medium:** 3.8 g of Mueller Hinton Agar (MHA) was added with 100ml of distilled water. Then it autoclaved at 121°C for 15 minutes. Poured it uniformly in Petri plates and then set the agar properly in the require temperature for future use.

**Inoculums and Incubation:** 0.1mg of bacterial culture was transferred in agar plate. Then the plate was stood for 5min, before it prepared for tested different concentrations. The seed extract of pepper was loaded in different concentrations into the agar plate. Then incubate with the bacterial culture at 37°C for 24-48 hours in the incubator.

**Phytochemical screening of spices:**

- **Screening for alkaloids:** To 5 ml each of the spice extracts, 5 ml of aqueous hydrochloric acid was added on a steam bath at 60°C for 5 min. The spice extract was filtered with a 3 layered muslin cloth. In one ml of the filtrate, few drops of Draggendoff's reagent were added. The appearance of Blue-black turbidity was positive for alkaloids.
- **Screening for steroids:** 1 ml of extract was dissolved in 10 ml of chloroform and an equal volume of concentrated sulphuric acid was added by the sides of the test tube. The upper layer turns red and the sulphuric acid layer showed yellow with green fluorescence. This indicates the presence of steroids.
- **Screening for tannins:** 5ml of each extracts was stirred separately with 100 ml distilled water and filtered. One millilitre ferric chloride reagent was added to the filtrate. A blue-black or blue-green precipitate was an indication of the presence of tannin.
- **Screening for flavonoids:** 5 ml of dilute ammonia solution was added to the aqueous extract followed by the addition of 1 ml concentrated $H_2SO_4$. The appearance of yellow color indicated the presence of flavonoids.
- **Screening for saponins:** 5ml of each extracts were mixed with distilled water and shaken separately in a test tube. Frothing, which persists on warm heating was taken as preliminary evidence of the presence of the saponin.

**Table 1- Phytochemical study of black pepper.**

| Phytochemicals | Chloroform | Methanol | Ethanol |
|---|---|---|---|
| Alkaloids | + | - | + |
| Flavonoids | - | + | - |
| Tannins | - | - | - |
| Saponins | + | + | - |
| Steroids | - | + | + |

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## RESULTS AND DISCUSSION

For the extraction of the active compounds of Black pepper seed, we used both polar and non-polar solvents. Using the Agar diffusion method the antibacterial activities can be determined by measuring the diameter of the growth inhibition zone. The extract of Black pepper using different solvents like benzene, methanol, ethanol, and chloroform were screened to study antibacterial activity against both Gram-positive and Gram-negative bacteria. By using Agar cup method antibacterial activity was tested on Muller Hinton Agar (MHA). Various concentrations of extracts were prepared.

**Table 2- of black Antibacterial activity of Methanol extract pepper seeds against different bacteria**

| concentration | Zone of inhibition | | |
|---|---|---|---|
| | ***Staphylococcus aureus*** | ***Escherichia Coli*** | ***Salmonella typhi*** |
| **300** | **20.2±1** | **27.1±2** | **18.8±1** |
| **200** | **18.3±2** | **22.4±1** | **16.4±2** |
| **100** | **17.2±1** | **19.8±2** | **15.5±1** |
| **50** | **15.1±2** | **16.5±1** | **13.6±2** |

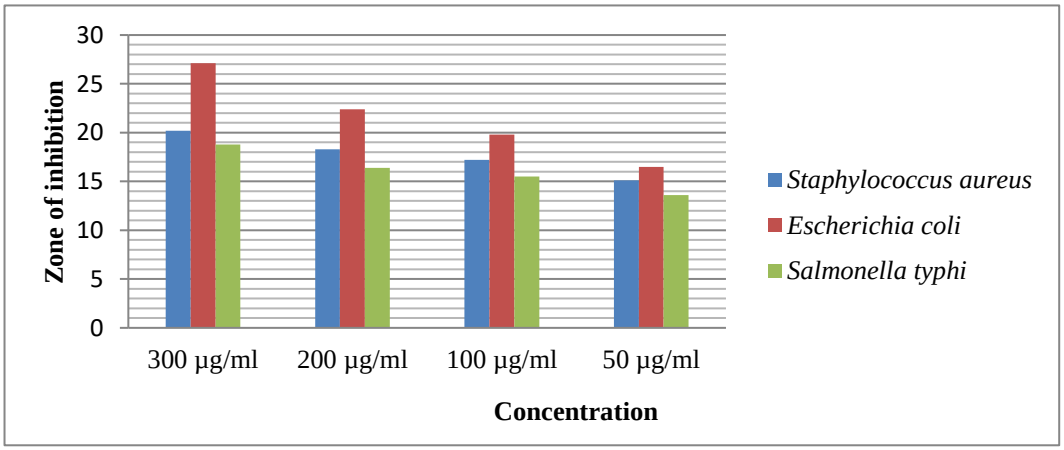


**Fig 2: Antibacterial activity of Ethanol extract of black pepper seeds against different bacteria.**

**Table 3- Antibacterial activity of Ethanol extract of black pepper seeds against different bacteria**

| concentration | Zone of inhibition | | |
|---|---|---|---|
| | ***Staphylococcus aureus*** | ***E. coli*** | ***Salmonella typhi*** |
| **300** | **38.0±1.0** | **33.0±2.0** | **32.4±1.0** |
| **200** | **33.0±2.0** | **32.1±1.0** | **28.3±2.0** |
| **100** | **27.3±1.0** | **26.3±2.0** | **25.0±1.0** |
| **50** | **24.8±22.0** | **22.2±0** | **19.6±2.0** |

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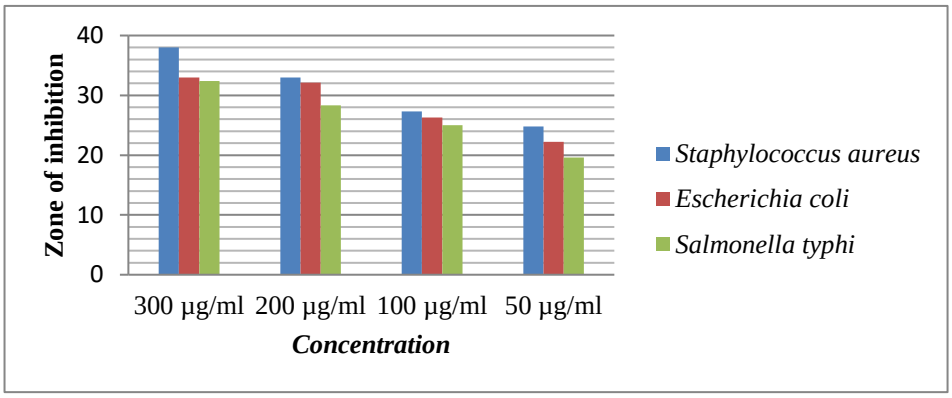


**Fig 3: Antibacterial activity of Ethanol extract of black pepper seeds against different bacteria.**

**Table 4-Antibacterial activity of Chloroform extract of black pepper seeds against different bacteria.**

| concentration | Zone of inhibition | | |
|---|---|---|---|
| | ***Staphylococcus aureus*** | ***E. coli*** | ***Salmonella typhi*** |
| **300** | **28.3±1.0** | **32.0±2.0** | **31.2±1.0** |
| **200** | **27.4±2.0** | **31.2±1.0** | **28.2±2.0** |
| **100** | **24.0±1.0** | **27.0±0** | **25.3±1.0** |
| **50** | **22.0±2.0** | **23.2±1.0** | **20.2±2.0** |

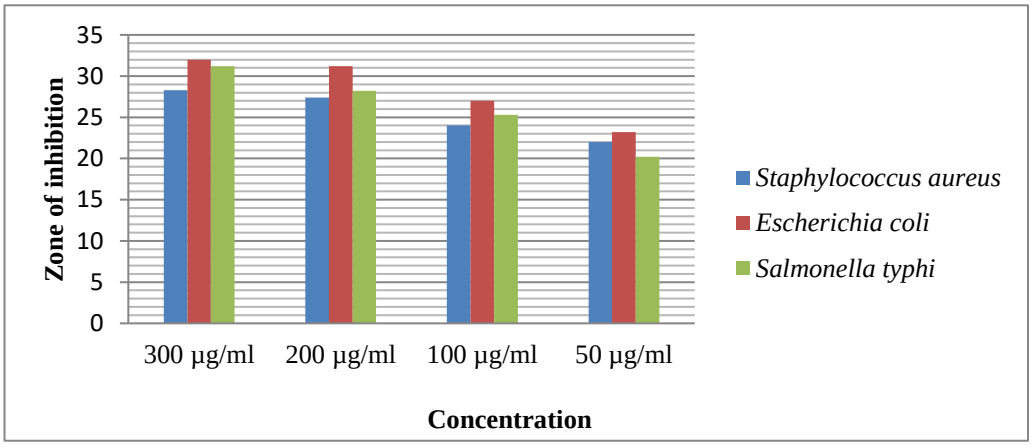


**Fig: 4 -Antibacterial activity of Chloroform extract of black pepper seeds against different bacteria.**

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## CONCLUSION

Black pepper extract has greater antibacterial activity. It was observed that Gram-positive bacteria are more susceptible than Gram-negative bacteria treated with Black pepper extract. After qualitative chemical analysis, we found alkaloid, flavonoid, tannins, saponins, and steroid from it. So, it is clear that we should be getting positive results by using Black pepper extract as an antibacterial agent.

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# 4. Date Palm: An Antimicrobial Agent with Its Nutritional Benefits

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## ABSTRACT

Date palm trees are known as the population of the Eastern zone, give a portion of food for human antibiotic resistant. Most of the natural products have an antibacterial effect which use in clinical purpose. Date palm is an essential nourishing source in the Eastern zone. The extraction of Date seed powder was done by using hexane and ethyl acetate solvents. Date palm pits show antibacterial activities on two bacteria (Klebsiella pneumonia and Escherichia coli) and its function is reducing the side effect on neurotransmitter are that brain, hormone, testosterone, muscle of male albino rats. The proper aim of this study is to use the nuclei dates as an antimicrobial on Klebsiella pneumonia and Escherichia coli than the pursuit of perfect antibiotics. It was identified that the methanol extract of date seed contains alkaloids, carbohydrates, phenols, flavonoids, protein, amino acid, tannins, and anthraquinones except steroids, saponins, and cardiac glycoside. The metabolic extract of date seed has also shown moderate inhibition on the growth of Gram-positive and Gram-negative bacteria.

## KEYWORDS

Resistant, Extraction, Neurotransmitter, Pursuit.

## Introduction

Antibiotic resistance is a biggest threat to global health. Approximately 5 lakhs persons of the world are infected by drug-resistant tuberculosis and Human Immuno Deficiency Virus. The Date palm (Phoenix dactylifera L.) is one of the most noteworthy sources of food which

have antibacterial potential. The percentage of reducing sugar is 88% in varieties and the percentage of non-reducing sugars is 3.82%. Dates are contemplated a tonic. The flower of the plant is used as economic source. Date palm cures male fertility by increasing sperm number and quality. Dates (Phoenix dactylifera) are an important nutritional source in many countries of the world, because of the Dates containing different nutrients such as carbohydrates, vitamins, and minerals. Date palm flowering and fruiting were also valuable. All of the Dates accommodate the various qualitative and quantitative amounts of phytochemicals.

Natural phytochemicals, such as phenolic compounds, which need for human health, showed the most antioxidant activity. In addition to antioxidant activity that helps the study demonstrated the antibacterial activity of phenols and phenolic compounds. The seed powder is also used as a coffee replacement and as food involves. The seed also yields essential fatty acids such as Palmitic acid, Stearic acid, Lauric acid, Oleic acid, and Linoleic acid. As Date Palm have different anticancer property, it is important to phytochemical analysis of Date Palm to find what agent is actually responsible for its function. The aim of the study is to profile to Date palm fruits and leaves and evaluate their functional significance such as antimicrobial activities to their nutritional benefits.

**Taxonomic Position:**

Kingdom: Plantae
Clade: Tracheophytes
Clade: Angiosperms
Clade: Monocots
Clade: Commelinids
Order: Articles
Family: Arecaceae
Genus: Phoenix
Species: P. dactylifera

**Fig 1: Date Palm**

**Materials and Methods:**

The Date seed was extracted by using Ethyl acetate and Hexane.

## Collection of seeds:

**Design Implementation**

- The Date seed (Phoenix dactylifera) was selected for the study of antimicrobial activity and phytochemical analysis. The seeds were collected from the fruit market in Arambagh, West Bengal, India. Phoenix dactylifera seeds were collected. First seeds were washed with cold water and then with hot water. Then seeds were dried in room temperature at 37 degree Celsius for 7-10 days.

Then seeds were air dried and powdered. Date seed powder of 200g was added to 400ml hexane and incubated in a shaker at room temperature. After 24 h incubation, the solvent was filtered from the mixture and the powder was dried and used again for extraction using 400 ml ethyl acetate by incubating for 24 h in a shaken. The solvent was filtered and stored in a bottle.

**Fig 2: Date Palm Seed**

**Fig 3: Seed Extracts of Date Palm**

## Site of Experiments:

The whole experiments were carried out in the laboratory room of Rabindra Mahavidyalaya, Champadanga, Hooghly, and West Bengal, India.

## Collection of Microorganisms:

The tested microorganisms are Escherichia coli and Klebsiella pneumonia.

## Preparation of Different Seed Extracts

### Benzene Extract:

About 5 g of dried seeds were taken and powdered to store. Then dispersed in 25 ml of benzene solution and shake it for 10 minutes. Then used with paper and tied with the rubber band. Few holes were made in the paper air circulation and took it in room temperature at 370C, maintenance for 4 days.

### Hexane Extract:

About 5 g of dried seeds were taken and powdered to store. Then dispersed in 25 ml of hexane solution and shake in for 10 minutes. Then used with paper and tied with the rubber band. Few holes were made in the paper air circulation and took it in room temperature at 370C, maintenance for 4 days.

### Chloroform Extract:

About 5 g of dried seeds were taken and powdered to store. Then dispersed in 25 ml of chloroform solution and shake in for 10 minutes. Then used with paper and tied with the rubber band. Few holes were made in the paper air circulation and took it in room temperature at 370C, maintenance for 4 days.

#### Ethyl acetate Extract:

About 5 g of dried seeds were taken and powdered to store. Then dispersed in 25 ml of ethyl acetate solution and shake in for 10 minutes. Then used with paper and tied with the rubber band. Few holes were made in the paper air circulation and took it in room temperature at 370C, maintenance for 4 days.

#### Methanol Extract:

About 5 g of dried seeds were taken and powdered to store. Then dispersed in 25 ml of methanol solution and shake in for 10 minutes. Then used with paper and tied with the rubber band. Few holes were made in the paper air circulation and took it in room temperature at 370C, maintenance for 4 days.

## Preparation of Extract Concentration:

Four extracts of Benzene, Chloroform, Hexane and Ethyl acetate of 50µg/ml, 100µg/ml, 200µg/ml and 400µg/ml concentration were mixed respectively by using DMSO to analyse the extract which were most effective to inhibit bacteria.

## Microbiological Assay by Agar Disc Diffusion Method:

For antimicrobial screening of seed extract Phoenix dactylifera 3 gm of each extracts were dissolved in 10 ml Dimethyl Sulphoxide (DMSO) from 25µg/ml, 75µg/ml, 150µg/ml, and 300µg/ml concentration were taken for the antimicrobial activity. A hollow tube was heated and inoculated in the agar plate. It was removed as soon as possible by making a good plate each plate was for only one DMSO control.

## Medium:

3.8 gm. of Mueller Hinton Agar (MHA) was added to 100ml of water and autoclaved at 1210C for 20 minutes at 15 lb./inch square and transferred to a sterile Petri dish and clotted the agar at low temperature.

## Inoculum and Incubation:

Inoculate 1gm of culture in Agar plate for 5min then as per previous concentrations kept it at 370C temperature for 24-48 hours. Measured the diameter of zone of inhibition area accurately. As per this method made each extracts of required concentrations.

**Phytochemical Estimation:**

## Extract Preparation:

20 gm. of dry powder was dispersed in methanol, ethyl acetate, hexane, benzene, and chloroform in a conical flask and shaken for 20 hours. Then the precipitation was collected.

## Phytochemical Studies:

The methods described by air borne microorganisms were used to test for the presence of ingredients in the test sample.

## Test of Steroids:

About 10 ml of seed extract (methanol, ethyl acetate, hexane, benzene, chloroform) was taken to dry mass, and the mass is dissolved in 0.5 ml of chloroform.

## Test for Alkaloids:

The seed extract (methanol, ethyl acetate, hexane, benzene, chloroform) was mixed with 5ml of 1% HCL on a steam bath. The solvent was filtered, and 1 ml of the filtrate was treated with Mayer's reagent.

**Test for Tannins:** About 1 g of plant extract powder was baked and 10 ml of distilled water added. The mix up was boiled 10 minutes. Two drops of 5% FeCl3 were added.

**Test for Flavonoids:** A drop of NH solution is added to the seed extract in a test tube for observation of yellow colour.

**Test for Reducing Sugar:** To 0.5 ml extract solution, 1 ml of water and 8 drops of Fehling's solution were added at hot water and then red precipitation was observed.


**Fig 4: Zone of Inhibition of Escherichia Coli Against Ethanol Extract**

| Phytochemicals | *Phoenix dactylifera L.* | | |
|---|---|---|---|
| | **Chloroform** | **Methanol** | **Ethanol** |
| Alkaloids | - | - | - |
| Anthraquinones | - | ++ | - |
| Catechin | - | +++ | +++ |
| Flavonoids | - | - | - |
| Glycosides | - | +++ | +++ |
| Phenolic groups | - | ++ | + |
| Reducing sugars | - | +++ | - |
| Saponins | - | +++ | +++ |
| Tannins | - | +++ | +++ |
| Terpenoids | ++ | - | - |

| Table 1: Antibacterial activity of the *Phoenix dactylifera* in different bacteria for hexane extract in different concentration | | | | |
|---|---|---|---|---|
| **Test Microorganism** | **Concentration(µg/ml)** | | | |
| | **100µg/ml** | **50µg/ml** | **25µg/ml** | **12.5µg/ml** |
| *Escherichia coli* | 27.25±2.0 | 22.25±2.0 | 18.25±2.0 | 17.25±2.0 |
| *Bacillus subtilis* | 28.5±3.0 | 27.25±2.0 | 21.25±2.0 | 18.5±3.0 |
| *Staphylococcus aureus* | 36.1±3.0 | 27.4±3.0 | 23.7±2.0 | 20.0±2.0 |
| *Klebsiellapneumonia* | 32.3±2.0 | 28.2±3.0 | 23.0±2.0 | 19.5±2.0 |
| *Pseudomonas aeruginosa* | 34.5±2.0 | 31.7±2.0 | 26.0±2.0 | 21.2±3.0 |
| *Salmonella enteritis* | 29.0±2.0 | 26.2±3.0 | 23.1±2.0 | 19.4±3.0 |

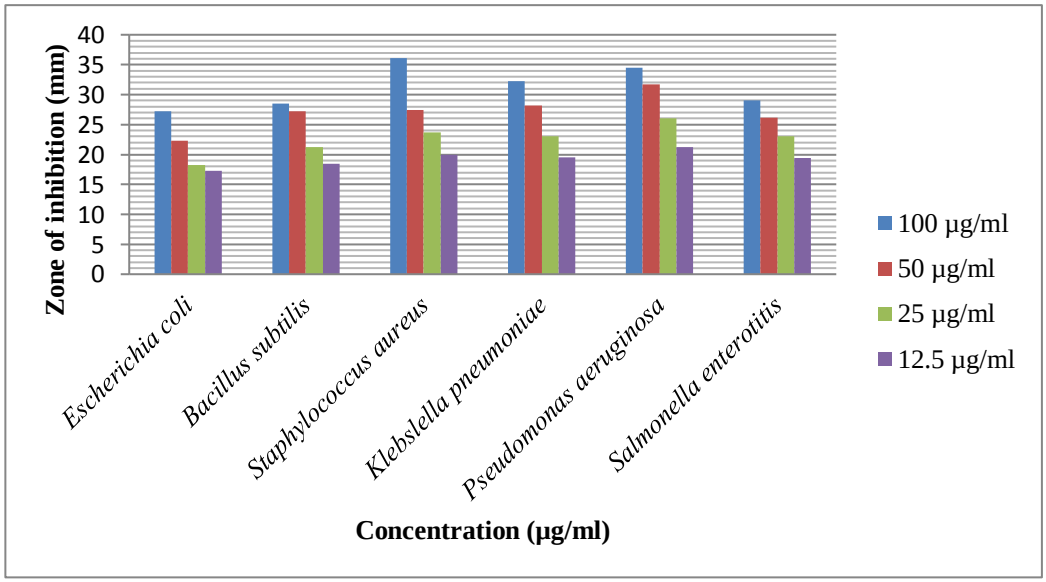


**Fig 5: Antibacterial activity of the Phoenix dactylifera in different bacteria for hexane extracts in different concentration**

| **Table 2: Antibacterial activity of the *Phoenix dactylifera* in different bacteria for chloroform extract in different concentration** | | | | |
|---|---|---|---|---|
| **Test microorganism** | **Concentration(µg/ml)** | | | |
| | **100 µg/ml** | **50 µg/ml** | **25 µg/ml** | **12.5 µg/ml** |
| *Escherichia coli* | 27.2±2.0 | 22.5±2.0 | 18.25±2.0 | 17.25±2.0 |
| *Bacillus subtilis* | 32.5±3.0 | 29..25±2.0 | 22.25±2.0 | 19.5±2.0 |
| *Staphylococcus aureus* | 35.1±3.0 | 29.4±3.0 | 26.7±2.0 | 21.0±0.0 |
| *Klebsiella pneumonia* | 32.3±2.0 | 28.0±2.0 | 25.0±2.0 | 22.5±2.0 |
| *Pseudomonas aeruginosa* | 32.5±2.0 | 30.7±2.0 | 28.0±2.0 | 21.2±3.0 |
| *Salmonella enteritis* | 33.0±2.0 | 30.2±3.0 | 28.1±2.0 | 18.4±3.0 |

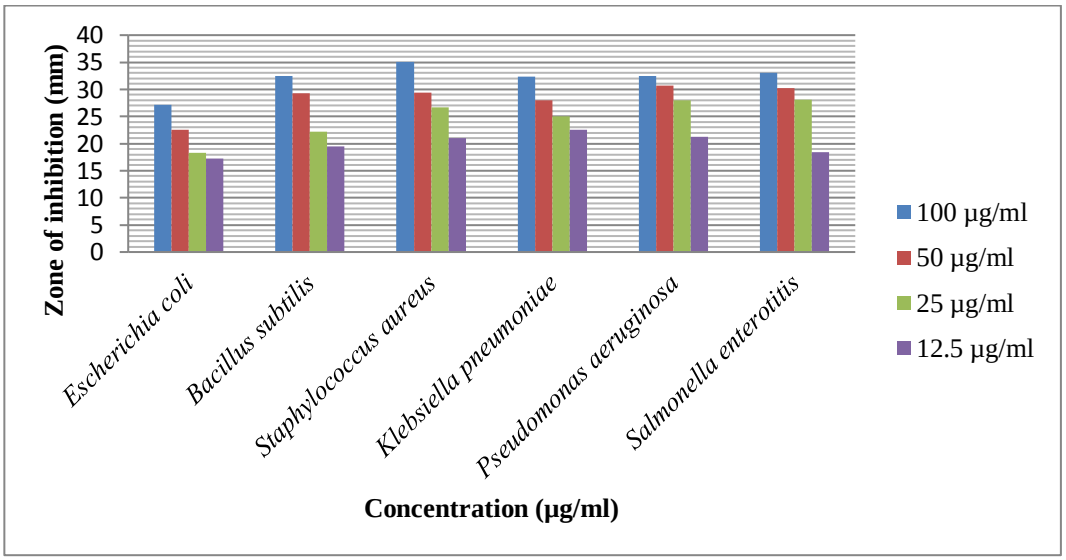


**Fig 6: Antibacterial activity of the Phoenix dactylifera in different bacteria for chloroform extract in different concentration.**

| Table 3: Antibacterial activity of the *Phoenix dactylifera* in different bacteria for benzene extract in different concentration | | | | |
|---|---|---|---|---|
| **Test microorganism** | **Concentration(µg/ml)** | | | |
| | **100 µg/ml** | **50 µg/ml** | **25 µg/ml** | **12.5 µg/ml** |
| *Escherichia coli* | 27.2±2.0 | 22.5±2.0 | 18.25±2.0 | 17.25±2.0 |
| *Bacillus subtilis* | 32.5±3.0 | 29..25±2.0 | 22.25±2.0 | 19.5±2.0 |
| *Staphylococcus aureus* | 35.1±3.0 | 29.4±3.0 | 26.7±2.0 | 21.0±0.0 |
| *Klebsiella pneumonia* | 32.3±2.0 | 28.0±2.0 | 25.0±2.0 | 22.5±2.0 |
| *Pseudomonas aeruginosa* | 32.5±2.0 | 30.7±2.0 | 28.0±2.0 | 21.2±3.0 |
| *Salmonella enteritis* | 33.0±2.0 | 30.2±3.0 | 28.1±2.0 | 18.4±3.0 |

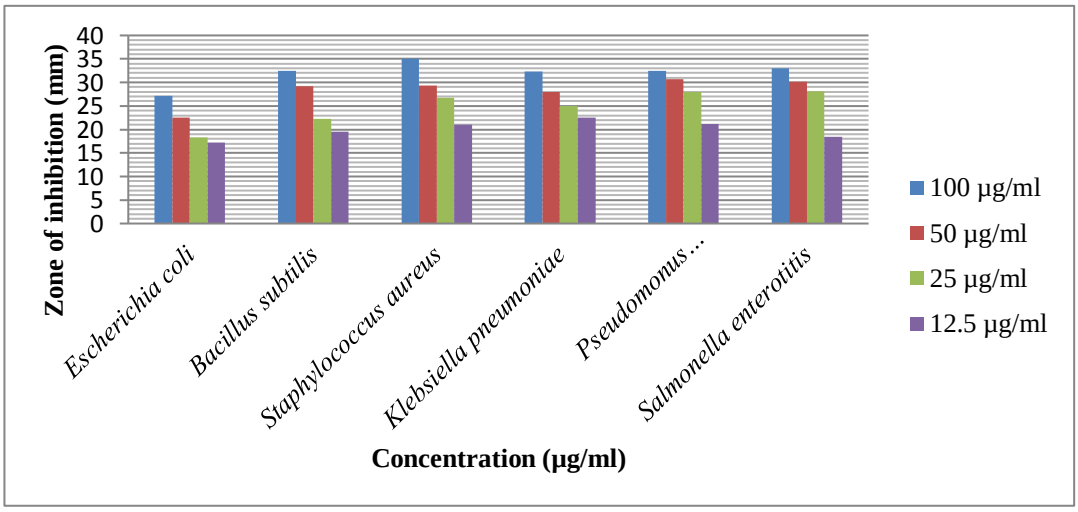


**Fig 7: Antibacterial activity of the Phoenix dactylifera in different bacteria for benzene extract in different concentration**

| **Table 4: Antibacterial activity of the *Phoenix dactylifera* in different bacteria for ethyl acetate extract in different concentration** | | | | |
|---|---|---|---|---|
| **Test microorganism** | **Concentration(µg/ml)** | | | |
| | **100 µg/ml** | **50 µg/ml** | **25 µg/ml** | **12.5 µg/ml** |
| *Escherichia coli* | 37.2±2.0 | 32.5±2.0 | 28.25±2.0 | 24.25±2.0 |
| *Bacillus subtilis* | 42.5±3.0 | 39.25±2.0 | 32.25±2.0 | 29.5±2.0 |
| *Staphylococcus aureus* | 44.1±3.0 | 39.4±3.0 | 36.7±2.0 | 33.4±0.0 |
| *Klebsiella pneumonia* | 41.3±2.0 | 38.0±2.0 | 35.0±2.0 | 32.5±2.0 |
| *Pseudomonas aeruginosa* | 35.3±2.0 | 33.7±2.0 | 28.0±2.0 | 25.2±3.0 |
| *Salmonella enteritis* | 43.0±2.0 | 35.2±3.0 | 33.1±1.0 | 29.9±3.0 |

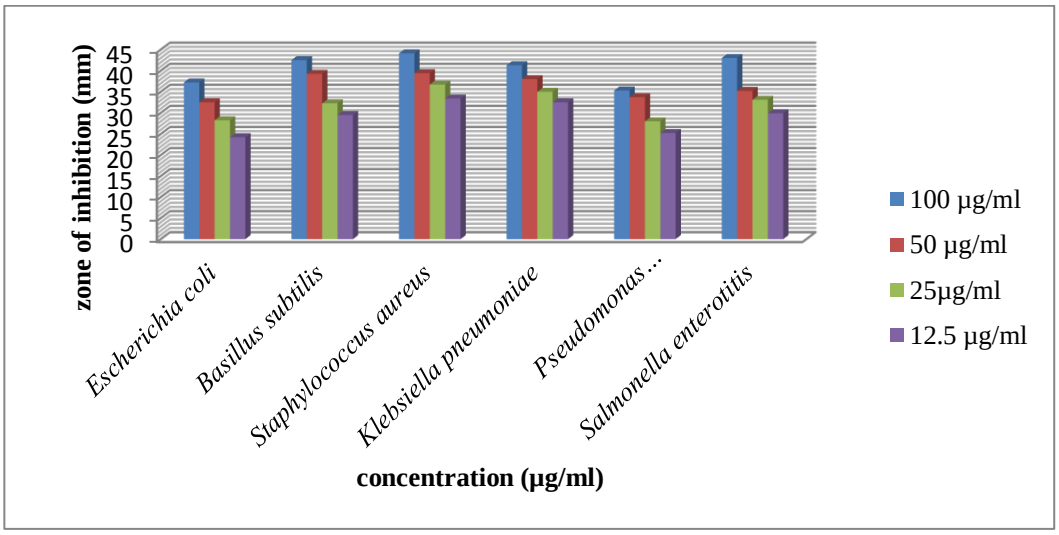


**Fig 8: Antibacterial activity of the Phoenix dactylifera in different bacteria for ethyl acetate extract in different concentration**

**Conclusion:**

Many plants, their fruits, and their seeds have many medicinal values that help in our health and other purposes. The study on Date seeds extract shows many antibacterial activities on different bacteria. The antibiotics treated to resist many bacteria, ampicillin, the plant extract as the same concentrations inhibit many bacteria. In this research, we observed the result of phytochemicals in my study. It is an inference that Phoenix dactylifera L. seed powders contain the chemical constituents like alkaloids, saponins, flavonoids, terpenoids, glycosides, steroids and phenolic compounds in this plant seed. However, it recommended that further work can be carried out to isolate the bioactive constituents in Phoenix dactylifera L.

Sing various extraction solvent with a view characteristics the presence of chemical such as the plant seed. This plant seed plays an important role in the fields of pharmaceutical and medicine and also treats infectious disease among the plant the best result respectively.

**Future Aspects:**

As plants have no side effects for human health, it can be used in treatment of many diseases. Date seeds are found useful in treating blood sugar related problems, diabetes, and related complications. According to recent research, Date seeds have shown potential for protective effects against early diabetic complications of both liver and kidney. Date seed oil is obtained from Date seeds through a Soxhlet extraction technique. Date seed oil is mainly composed of the four fatty acids namely oleic, linoleic, Lauric, and Palmitic acid. Listed below are some of the well-known health benefits of using Date seed oil. Some people use Date seeds as an additive to coffee. Add Date syrup into the warm water with lemon and drink as a tea or infused water. Try to make healthy bread spread. Just blend Date syrup with honey or Jaggery. Use this instead of jam.

Add Date powder into your smoothies or juices. Add Date palm seed powder into your baking dishes like cookies, cakes, etc. Add Date syrup while making the salad dressing for extra health benefits.

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# Green bell pepper to treat UTI, oral disease, intestinal infection through its phytochemical agent

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**Abstract**
The main reason for this study is to investigate the antibacterial activities of green bell pepper (*Capsicum annum*) against some common bacteria. Here three types of bacteria are used for this study such as *E. coli, S. mutant, P. vulgaris*. In this study, green bell pepper was used for its antibacterial activity against *E. coli* isolated from humans with Diarrhea, *S. mutant* isolated from human tooth decay, oral cavity, or inflammation on the buccal surface, and *P. vulgaris* isolated from the intestinal tract of human.

**Keywords:** reason, antimicrobial, isolated, inflammation

## Introduction
*Capsicum annum* is also known as "Green Bell Pepper". It is an automatic vegetable that is used as food, have a special spicy flavour. We take many antibiotics against many different diseases, but they have many side effects. Many pathogenic bacteria can also resistance this type of antibiotic. So many medicinal plants are used to resist them. There have no side effects. Green bell pepper is also used in the medicinal field. Green bell pepper is an excellent source of many phenolic compounds, bioactive compounds, antioxidants, free radicals, and vitamins. Green bell pepper consists of many antioxidant compounds such as Carotenoids, Vitamin C, Capsaicinoids, Fatty acids (linoleic acid, palmitic acid, and alpha-linolenic acid), Tocopherols, especially phenolic compounds (such as flavonoids and phenolic acids). Many free radicals belong to human etiology including cancer, cardiovascular disease, diabetes, etc. These phenolic compounds and other essential compounds may inhibit the growth of some microorganisms. Green bell pepper has some effective activity against *E. coli*, *S. mutant*, and *P. vulgaris*. *Escherichia coli* is a Gram-negative bacteria generally found lower intestine and also in the gut of some animals. Most types of *E. coli* are helped in our digestive system but some strains can cause Diarrhea if we take contaminated food or water. It also can cause urinary tract infections. *E. coli* produce Shiga toxin that makes us very sick. *Streptococcus mutant* is a Gram-positive bacteria mainly found in our buccal surface or oral cavity. It is a causative agent of our tooth decay. *S. mutant* causes an oral cavity in children. *Proteus vulgaris* is a Gram-negative bacterium that is found in our intestinal tract and also the fecal matter of animals. It can also occur some diseases like wound infection and urinary tract infection. So now we studied the antibacterial activities of *Capsicum annum* extract against some bacteria that are already discussed before in the text.

## Materials and Methods
### Site of Experiment
The total experiment was carried out in the laboratory room of Rabindra Mahavidyalaya, Champadanga, Hooghly, West Bengal, India.

### Collection of Microorganisms
The tested microorganisms (*E. coli, Streptococcus mutant, and Proteus vulgaris*) brought together from MTCC Chandigarh, India. The microorganism's strains remained in Mueller Hinton Agar (MHA, pH -7.2) at 37 degrees Celsius. The stock culture remained at 4 degrees Celsius.

### Collection of Plant Material
The testing vegetable (*Capsicum annum*) was collected from the nearby market of Champadanga, Hooghly, W. B., India.


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**Fig 1 and 2:** *Capsicum annum*

**Taxonomic Position**
**Super kingdom:** Eukaryota
**Kingdom:** Viridiplantae
**Phylum:** Streptophyta
**Order:** Solanales
**Family:** Solanaceae
**Subfamily:** Solanoideae
**Tribe:** Capsiceae
**Genus:** Capsicum

**Fig 3:** Fruit extract (dust)

**Preparation of Fruit Extract**
At first, the collected vegetables were washed under the running tap water for 2-3 times. Then they are finally washed with distilled water and remain under shade for a few days at room temperature. Then the dried materials converted to dust by a mixer

**Different Extraction**
**Methanol Extraction**
To prepare methanol extraction, at first we take 5gm of dried powder of fruit extract of *Capsicum annum* in a 100ml conical flask and added 20ml of methanol and shake them very carefully. Then they were covered with a tissue paper tightly with a rubber band. At last, some small pores created above the tissue paper for passing air and evaporation. They transferred at room temperature for 48 hours.

**Fig 4:** Methanol extraction

**Ethanol Extraction**
To prepare ethanol extraction, at first we take 5gm of dried powder of fruit extract of *Capsicum annum* in a 100ml conical flask and added 20ml of ethanol and shake them very carefully. Then they were covered with a tissue paper tightly with a rubber band. At last, some small pores created above the tissue paper for passing air and evaporation. They transferred at room temperature for 48 hours.

**Acetone Extraction**
To prepare acetone extraction, at first we take 5gm powder of fruit extract of *Capsicum annum* in a 100ml conical flask and added 20ml of acetone and shake them very carefully. Then they were covered with a tissue paper tightly with a rubber band. At last, some small pores created above the tissue paper for passing air and evaporation. They transferred at room temperature for 48 hours.

**Benzene Extraction**
To prepare benzene extraction, at first we take 5gm of dried powder of fruit extract of *Capsicum annum* in a 100ml conical flask and added 20ml of benzene and shake them very carefully. Then they were covered with a tissue paper tightly with a rubber band. At last, some small pores created above the tissue paper for passing air and evaporation. They transferred at room temperature for 48 hours.

**Preparation of extract concentration**
We prepare four extracts before. From these four extractions *viz*. Methanol, Ethanol, Acetone and Benzene, using DMSO we prepared four concentrations such as 50µg/ml, 100µg/ml, 200µg/ml, and 400µg/ml.

**Collection of Antibiotics**
The antibiotics (Ampicillin) were collected from the nearby market of Champadanga, Hooghly, West Bengal, India.

**Microbiological Assay**
**Agar Disc Diffusion Method**
The antibacterial screening of fruit extract of *Capsicum annum* was prepared by dissolving 4gm of each extract separately in 10ml Dimethyl Sulphoxide (DMSO). The prepared diluted extract was used for microbial study. Sterile Agar Medium was bored to create a suitable wall in the Petri plate by using a borer. Only two wells were created on a Petri plate, one of these remains for control (DMSO), and the other well is used for antibiotics of similar concentration.

**Medium**
At first, we take 100ml of water then added 3.8gm of Mueller Hinton Agar (MHA). They shake very well. Then it autoclaved at 1210C for 15 minutes at fifteen lbs and transferred to a Petri plate, which is already sterile. The agar pours homogeneously thickness about 4 millimetres. Then the agar remains at a low temperature until it became cool.

**Inoculums and Incubation**
In the agar plates, 0.1ml of microorganism's cultures was transferred.
The inoculated plates were remained for 5 minutes before creating wells in the agar for different concentrations to be tested.
Then the extracts of *Capsicum annum* were poured at different concentrations in the well on the agar plate. Then the plates were allowed to incubate at 37 degrees Celsius for 24-48 hours in a laboratory incubator.

**Statistical Analysis**
After incubation, we see a clear zone around the well in the plate that is called the "zone of inhibition". We measured the zone of inhibition using a zone reader. We take three nearly similar values of the zone of inhibition for each concentration of *Capsicum annum* extract. The obtained

values were analyzed using SIGMAPLOT software (version – 14.0). The resulting data were analyzed by using "t-test".

**Phytochemical Estimation**

**Extract Preparation**

20gm of dry powder was added in Methanol, Ethanol, Acetone, and Benzene in a conical flask. They are shaken carefully in a rotator shaker for 24 hours. Then we collected the supernatant and the solvent was evaporated.

**Phytochemical Studies**

The Phytochemical study is a qualitative study. Phytochemical constituents are the medicinal value that lies in these plants, leaves, fruits, or the part which tested that produces physiological action on the human body. The phytochemicals have a great role in the pharmacognostic drug development and treatment of many ailments. There are found man phytochemicals such as steroids, alkaloids, tannins, flavonoids, reducing sugar, and different phenols.

**Test for Steroids**

When we tested for steroids, we take 2ml of the test solution and mixed it with 2ml of Acetic Anhydride followed by 2ml of Sulphuric Acid.

Then we see the color changed from violet to blue or green in some samples that indicate the steroids present in the solution.

**Test for Flavonoids:**

We take 2ml of the test solution which mixed with 4ml of 1% Aluminium Chloride in Methanol in a test tube. Then we observed that yellow color formed, indicated the presence of flavonoids.

**Test for Alkaloids**

Alkaloids are nitrogenous compounds which have much physiological and pharmacological activity. We detect the presence of Alkaloids by Mayer's reagent test. A few drops of Mayer's reagent added in the alkaloids solution that produced white-yellowish precipitate. The fruit extract was stirred with 5ml of 1% HCl on a steam bath. Then it filtered. Add 2 drops of Mayer's reagent in the 1ml filtrate and observe the precipitation and we know that alkaloids are present.

**Test for Tannins**

At first 1 gm of fruit extract powder was taken into a beaker and 10ml of distilled water add and the mixture boiled for 5 minutes. Then 2 drops of 5% FeCl3 were added. A blue-green color arises that indicates the presence of Tannins.

**Test for Reducing Sugar**

In 0.5 ml of extract solution, we added 1ml of water and 5-8 drops of Fehling's solution and hit them a few minutes. Then we observed a brick-red precipitate and sure that reducing sugar is present.

**Result**

We used both polar and non-polar solvents for the extraction of active components from the fruit of green bell pepper fruit. The antibacterial activities were determined using the agar disc diffusion method by measuring the diameter of the growth inhibition zone.

**Table 1:** Phytochemical analysis of secondary metabolites such as alkaloids, flavonoids, steroids, tannin, reducing sugar present in *Capsicum annum.*

| Phytochemicals compounds | Green bell pepper fruit |
|---|---|
| Alkaloids | +++ |
| Flavonoids | ++ |
| Steroids | - |
| Tannin | - |
| Reducing sugar | - |

**Table 2:** The antibacterial activity of Methanol extract of *Capsicum annum* against various bacteria.

| Concentration (µg/ml) | Zone of inhibition (mm) | | |
|---|---|---|---|
| | ***Escherichia coli*** | ***Streptococcus mutant*** | ***Proteus vulgaris*** |
| 400 µg/ml | 36.5±1.0 | 38.0±2.0 | 32.8±2.0 |
| 200 µg/ml | 32.2±2.0 | 33.2±1.0 | 30.0±1.0 |
| 100 µg/ml | 28.6±1.0 | 29.0±2.0 | 27.1±1.0 |
| 50 µg/ml | 25.2±0.0 | 25.7±0.0 | 22.2±2.0 |

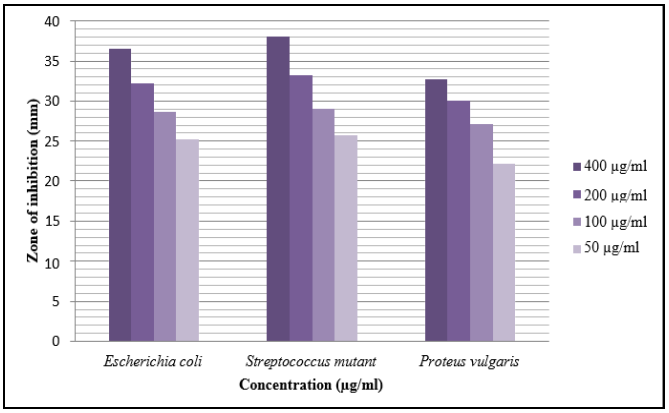


**Fig 5:** The antibacterial activity of Methanol extract of *Capsicum annum* against various bacteria.

**Table 3:** The antibacterial activity of Ethanol extract of *Capsicum annum* against various bacteria.

| Concentration (µg/ml) | Zone of inhibition (mm) | | |
|---|---|---|---|
| | ***Escherichia coli*** | ***Streptococcus mutant*** | ***Proteus vulgaris*** |
| 400 µg/ml | 37.0±1.0 | 40.0±2.0 | 34.4±2.0 |
| 200 µg/ml | 33.0±2.0 | 36.2±1.0 | 31.2±1.0 |
| 100 µg/ml | 28.8±2.0 | 29.1±2.0 | 28.0±1.0 |
| 50 µg/ml | 25.8±1.0 | 26.2±0.0 | 23.6±2.0 |

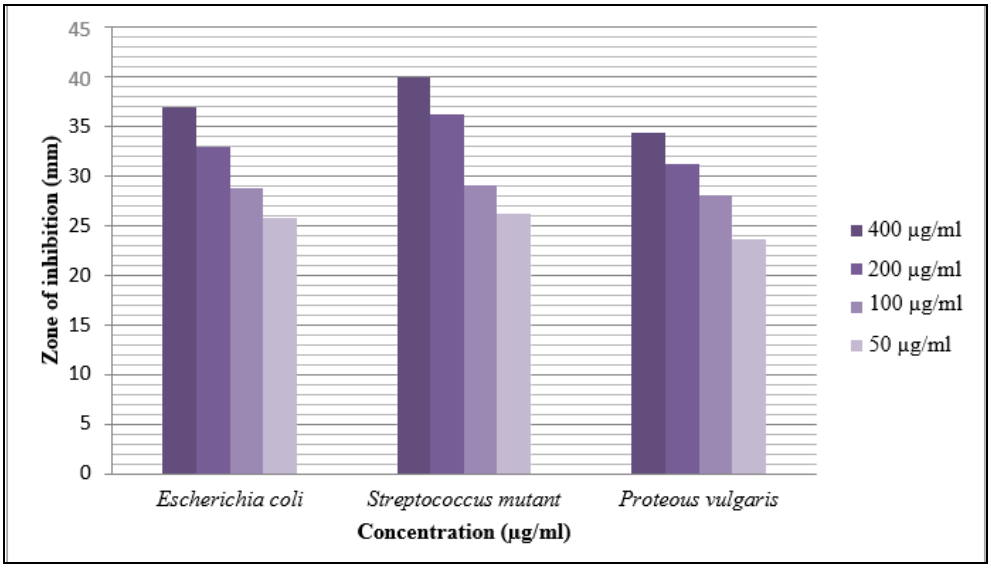


**Fig 6:** The antibacterial activity of Ethanol extract of *Capsicum annum* against various bacteria

**Table 4:** The antibacterial activity of Acetone extract of *Capsicum annum* against various bacteria

| Concentration (µg/ml) | Zone of inhibition (mm) | | |
|---|---|---|---|
| | ***Escherichia coli*** | ***Streptococcus mutant*** | ***Proteus vulgaris*** |
| 400 µg/ml | 32.0±1.0 | 36.0±2.0 | 30.0±2.0 |
| 200 µg/ml | 28.2±2.0 | 30.2±1.0 | 26.4±1.0 |
| 100 µg/ml | 25.4±2.0 | 27.0±2.0 | 24.1±0.0 |
| 50 µg/ml | 23.0±3.0 | 24.2±0.0 | 21.0±2.0 |

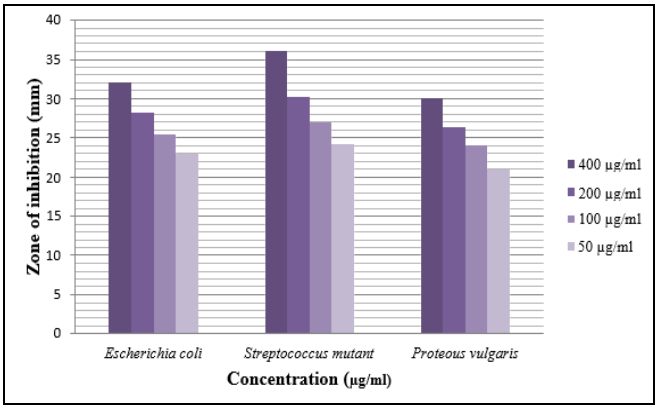


**Fig 7:** The antibacterial activity of Acetone extract of *Capsicum annum* against various bacteria

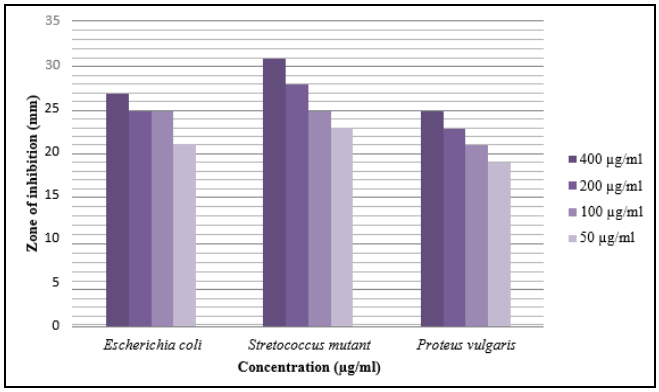


**Fig 8:** The antibacterial activity of Benzene extract of *Capsicum annum* against various bacteria.

**Table 5:** The antibacterial activity of Benzene extract of *Capsicum annum* against various bacteria

| Concentration (µg/ml) | Zone of inhibition (mm) | | |
|---|---|---|---|
| | ***Escherichia coli*** | ***Streptococcus mutant*** | ***Proteus vulgaris*** |
| 400 µg/ml | 26.8±1.0 | 30.6±2.0 | 25.0±2.0 |
| 200 µg/ml | 25.0±0.0 | 28.1±0.0 | 23.4±1.0 |
| 100 µg/ml | 24.6±2.0 | 25.2±2.0 | 20.8±1.0 |
| 50 µg/ml | 21.4±3.0 | 23.4±1.0 | 19.2±2.0 |

## Conclusion

Many plants, their fruits, and their seeds have much medicinal values that help our health and other purposes. The study on green bell pepper fruit extract has much antibacterial activities on different bacteria. The antibiotics treated to resist many bacteria, ampicillin, the plant extract as the same concentrations inhibit many bacteria. So the fruit extract is used in many medicinal and pharmaceutical fields. The fruit extract is easy to prepare. So hopefully we use the

green bell pepper extract as a medicinal field. Therefore, green bell pepper could be effectively used as a natural spicy food in our everyday meal, for the prevention of bacterial infection. Indeed this phenomenal fruit may serve as a good resource for the spicy industry and clinical medicine. This research could be further extended to test the bioactive properties of green bell pepper for therapeutic uses.

**Future Aspect**

There were wide futures aspects of Research work with Green bell pepper. Green bell pepper should certainly find a place in the various treatment of bacterial infection. The results from the present study we concluded that it is very useful in the treatment of bacterial infection. It was discovered that the phytochemicals present in the green bell pepper extract inhibited the growth of microorganisms and the result compared with antibiotics, Ampicillin commonly used in therapeutics and they showed less strong inhibition for Gram-negative bacteria and more strong inhibitory effect for Gram-positive bacteria. *Capsicum annum* shows significant activity as because the fruit contains many useful phytochemical compounds which have much medicinal values in the treatment of diarrhea, pneumonia, urinary tract infection, wound infection, tooth decay, etc.

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# Molecular Identification of Antibiotic Producing and Different Enzyme Producing Ability of Halophilic Bacteria Obtained from Costal Area of Bay of Bengal

By

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# RABINDRA MAHAVIDYALAYA, CHAMPADANGA

(Affiliated to University of Burdwan)

**Department of Microbiology**

Celebrates

**NATIONAL SCIENCE WEEK 2024**

## Certificate of Resource Person

*This is to certify that **Dr. Tanmay Ghosh**, Assistant Professor of Microbiology, Dinabandhu Andrews College, University of Calcutta participated as a 'Resource Person' in the Seminar on "Isolation and phylogenetic Identification of seed borne Mycoflora with wheat seed & eco-friendly Management by Moringa oleifera with phytochemical screening : GC-MS Analysis" organized by Rabindra Mahavidyalaya, Department of Microbiology to observe NATIONAL SCIENCE WEEK 2024 (28th February to 5th March, 2024).*

Debasmita Sardar

05.03.24

| Dr. Debasmita Sardar | Prof. Nayeem Ahmed Khan | Dr. Prasanta Bhattacharyya |
|---|---|---|
| Convenor | HOD (Microbiology) | Principal |
| Rabindra Mahavidyalaya | Rabindra Mahavidyalaya | Rabindra Mahavidyalaya |

**Programme details:** On behalf of Dinabandhu Andrews College & Rabindra Mahavidyalaya in collaboration we went to the farming land and participated in an outreach programme with the farmers and students.There we gave various useful advice to the farmers regarding Agricultural farming. Also,we informed the farmers about various modern farming methods,Use of Organic fertilizers and assured the college to support them in their various problems.

**Objectives of the Programme:** The objectives of an Agricultural Awareness Programme typically include educating people about sustainable farming practices, promoting agricultural innovation and technology adoption, raising awareness about the importance of agriculture in food security, and encouraging youth involvement in farming. Additionally, these programmes often aim to enhance public understanding of environmental conservation and the role of agriculture in economic development.

**Outcomes of the Programme:** The outcomes of an Agricultural Awareness Programme can vary, but typically include increased knowledge and understanding of sustainable farming practices among participants, improved adoption of agricultural innovations and technologies, enhanced appreciation for the importance of agriculture in ensuring food security, greater involvement of youth in farming activities, and heightened awareness of the connection between agriculture, the environment, and economic development. Additionally, such programmes may lead to increased support for policies and initiatives aimed at promoting agricultural sustainability and rural development.


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Galaxy S23 Ultra Dr Tanmay


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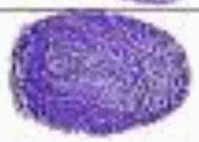
| |  | | |
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| | সরস্বতীর গোলদি | | সার |
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