Janata Shikahan Sanstha's
Kisan Veer Mahavidyalaya, Wai
Student List M.Sc.- II Chemistry
2024-25

Sr. No	Roll No.	Student's Name	Project Name
1	15	SANAS ABHISHEK RAJKUMAR	SYNTHESIS AND CHARACTERIZATION OF COBALT PHOSPHATE BY CO PRECIPITATION METHOD FOR SUPERCAPACITOR APPLICATION
2	14	PAWAR PRATHEMESH RAJENDRA	
3	8	DHAGE OMKAR VIJAY	
4	9	WAGHAMARE VISHAL PRAKASH	SYNTHESIS OF NICKEL PHOSPHATE BY CHEMICAL CO PRECIPITATION METHOD FOR HIGH PERFORMANCE SUPERCAPACITOR
5	26	SALUNKHE SUSHANT SANTAJI	
6	13	DHUMAL ABHISHEK NANDKUMAR	
7	11	MORE SUYOG PRAMOD	SYNTHESIS OF NICKEL COBALT TANGSTATE BY CHEMICAL CO PRECIPITATION METHOD FOR SUPERCAPACITOR
8	10	WAGH OMKAR SHIVAJI	
9	7	MANDHARE ABHISHEK SANJAY	
10	25	CHIKANE SIDDHI RAMESH	SYNTHESIS AND ANTIMICROBIAL ACTIVITY OF AZO DYES INCORPORATING HETEROCYCICS
11	19	PUJARI KIRTI CHENNA	
12	24	THORAE PRIYANKA DINESH	
13	18	BAGWAN SHAHISTA HASAN	
14	21	SATPUTE SAYALI ANANDA	SYNTHESIS OF NICKEL COBALT PHOSPHATE BY SILAR METHOD FOR ENERGY STORAGE APPLICATION
15	20	SHINDE SAURABH MOHAN	
16	22	SHINDE AKASH PANDURANG	
17	3	SHIVTHARE SONAM SAMBHAJI	SYNTHESIS OF MAGNESIUM COBALT TANGSTATE BY CHEMICAL CO PRECIPITATION METHOD FOR SUPERCAPACITOR
18	5	NIKAM KAJAL VIKAS	
19	6	SHIVTHARE PRAFULLA SANJAY	
20	12	PISAL SUSHMA AJIT	SYNTHESIS OF ZINC SALPHIDE BY SILAR METHOD FOR HIGH PERFORMACE SUPERCAPACITOR
21	17	KAMATHE ANKITA PRASHANT	

Head
Department of Chemistry
Kisan Veer Mahavidyalaya, Wai

JANATA SHIKSHAN SANSTHA'S

KISAN VEER MAHAVIDYALAYA, WAI

DEPARTMENT OF CHEMISTRY

Certificate

This is to certify that the project report entitled **"SYNTHESIS AND CHARACTERIZATION OF COBALT PHOSPHATE BY CO-PRECIPITATION METHOD FOR SUPERCAPACITOR APPLICATION"** submitted by Mr. Abhishek Rajkumar Sanas, Prathamesh Rajendra Pawar ,Omkar Vijay Dhage in fulfilment of the project work, prescribed by Shivaji University, Kolhapurfor M.Sc. course in organic chemistry have been completed satisfactorily under my guidance year 2024-2025.

Place: Wai

Date: 11/4/25

KISAN VEER MAHAVIDYALAYA Wai, Dist. Satara

Dr. S. B. Wategaonkar
(Project Guide)

Prof. (Dr.) D.N. ZAMBARE
(Head of Department)

Head
Department of Chemistry
Kisan Veer Mahavidyalaya, Wai

External Examiner

Shivaji University, Kolhapur

JANATA SHIKSHAN SANSTHA'S

KISAN VEER MAHAVIDYALAYA, WAI

DEPARTMENT OF CHEMISTRY

Certificate

This is to certify that the project report entitled submitted by Mr.Sushant Santaji Salunkhe, Mr. Vishal Prakash Waghmare Mr. Abhishek Nandkumar Dhumal in fulfilment of the project work, prescribed by Shivaji University, Kolhapur for M.Sc. course in organic chemistry have been completed satisfactorily under my guidance year 2024-2025.

Place: Wai

Date: 11/4/25

Dr. S. B. Wategaonkar
(Project Guide)

Prof.(Dr.) D.N. Zambare
Head
Department of Chemistry
Kisan Veer Mahavidyalaya, Wai

External Examiner

Shivaji University, Kolhapur

JANATA SHIKSHAN SANSTHA'S

KISAN VEER MAHAVIDYALAYA, WAI

DEPARTMENT OF CHEMISTRY

Certificate

This is to certify that the project report entitled **"SYNTHESIS OF NICKEL COBALT TUNGSTATE ($NiCoWO_4$) BY CHEMICAL COPRECIPITATION METHOD FOR SUPERCAPACITOR"** submitted by Mr. Suyog Pramod More Mr. Omkar Shivaji Wagh Mr. Abhishek Sanjay Mandhare in fulfilment of the project work, prescribed by Shivaji University, Kolhapur for M.Sc. course in organic chemistry have been completed satisfactorily under my guidance year 2024-2025.

Place: Wai

Date: 11/4/25

Dr. S. B. Wategaonkar
(Project Guide)

Prof.(Dr.) D. N. Zambare
(Head of Department)

Head
Department of Chemistry
Kisan Veer Mahavidyalaya, Wai

External Examiner
Shivaji University, Kolhapur

JANATA SHIKSHAN SANSTHA'S

KISAN VEER MAHAVIDYALAYA, WAI

DEPARTMENT OF CHEMISTRY

Certificate

This is to certify that the project report entitled "**SYNTHESIS AND ANTIMICROBIAL ACTIVITIES OF AZO DYES INCORPORATING HETEROCYCLICS**" submitted by **Miss. Pujari Kirti Chenna, Miss. Chikane Siddhi Ramesh, Miss. Thorave Priyanka Dinesh, Baghwan Shahista Hasan** in fulfilment of the research project work, prescribed by **SHIVAJI UNIVERSITY, KOLHAPUR** for M.Sc. course in organic chemistry have been completed satisfactorily under my guidance year 2024- 2025.

Place: Wai

Date: 11/04/2025

11/04/2025

Miss. P. S. JAIGUDE

(Research Guide)

Prof. (Dr). D. N. Zambare

Head, Department of Chemistry

Professor and Head
Department of Chemistry
Kisan Veer Mahavidyalaya, Wai

External Examiner

Shivaji University, Kolhapur

JANATA SHIKSHAN SANSTHA'S

KISAN VEER MAHAVIDYALAYA, WAI

DEPARTMENT OF CHEMISTRY

Certificate

This is to certify that the project report entitled **"SYNTHESIS OF NICKEL COBALT PHOSPHATE ($NiCOPO_4$) BY SILAR METHOD FOR ENERGY STROAGE APPLICATION"** submitted by Ms.Sayali Ananda Satpute,Mr.Saurabh Mohan Shinde,Mr.Akash Pandurang Shinde. in fulfilment of the project work, prescribed by Shivaji University, Kolhapur for M.Sc. course in organic chemistry have been completed satisfactorily under my guidance year 2024-2025.

Place: Wai

Date: 11/4/25

Dr. S. B. Wategaonkar
(Project Guide)

Prof. (Dr.) D. N. Zambare
(Head of Department)

External Examiner
Shivaji University, Kolhapur

JANATA SHIKSHAN SANSTHA'S

KISAN VEER MAHAVIDYALAYA, WAI

DEPARTMENT OF CHEMISTRY

Certificate

This is to certify that the project report entitled **"SYNTHESIS OF MAGNESIUM COPPER TUNGSTATE ($MgCuWO_4$) BY CHEMICAL COPRECIPITATION METHOD FOR SUPERCAPACITOR"** submitted by Miss.Sonam Sambhaji Shivhtare, Miss.Kajal Vikas Nikam, ,Mr.Prafulla Sanjay Shivthare in fulfilment of the project work, prescribed by Shivaji University, Kolhapur for M.Sc. course in organic chemistry have been completed satisfactorily under my guidance year 2024-2025.

KISAN VEER MAHAVIDYALAYA Wai, Dist. Satara

Place: Wai

Date: 11/4/25

Dr. S. B. Wategaonkar
(Project Guide)

Prof. (Dr.) D. N. Zambare
(Head of Department)

External Examiner
Shivaji University, Kolhapur

APRIL 2025

JANATA SHIKSHAN SANSTHA'S

KISAN VEER MAHAVIDYALAYA, WAI

DEPARTMENT OF CHEMISTRY

Certificate

This is to certify that the project report entitled **Synthesis of Zinc Sulphide by the SILAR Method for High Performance Supercapacitor** submitted by Miss. Sushma Ajit Pisal, Miss.Ankita Prashant Kamthe, Miss. Priti Govind Pisal in fulfilment of the project work, prescribed by Shivaji University, Kolhapur for M.Sc. course in organic chemistry have been completed satisfactorily under my guidance year 2024-2025.

Place: Wai

Date: 11/4/25

Dr. S. B. Wategaonkar
(Project Guide)

Prof. (Dr.) D. N. Zambare
(Head of Department)
Head
Department Of Chemistry
Kisan Veer Mahavidyalaya,Wai

External Examiner
Shivaji University, Kolhapur

JANATA SHIKSHAN SANSTHA'S

KISAN VEER MAHAVIDYALAYA, WAI

DEPARTMENT OF CHEMISTRY

Certificate

This is to certify that the project report entitled "MARIGOLD LIKE SPHERICAL MICROFLOWERS OF NICKEL COBALT TUNGSTATE ($NiCoWO_4$) : PROMISING ELECTRODE MATERIAL FOR SUPERCAPACITOR" submitted by Ms. Priti Dagadu Kochale, Ms. Prajakta Pravin Jagtap, Mr. Navnath Kabaji Thombare in fulfilment of the project work, prescribed by Shivaji University, Kolhapur for M.Sc. course in organic chemistry have been completed satisfactorily under my guidance year 2024-2025.

Place: Wai

Date: 11-04-2025

KISAN VEER MAHAVIDYALAYA Wai, Dist. Satara

Dr. S. B. Wategaonkar
(Project Guide)

Prof. (Dr.) D. N. Zambare
(Head of Department)

Department of Chemistry
Kisan Veer Mahavidyalaya, Wai

External Examiner
Shivaji University, Kolhapur

Sample Copy of Project

M.Sc II

2024-25

Janata Shikshan Sanstha's

Kisan Veer Mahavidyalaya, Wai

Dist. Satara, 412803 (MH)

SYNTHESIS AND ANTIMICROBIAL ACTIVITIES OF AZO DYES INCORPORATING HETEROCYCLICS

A DESSERTATION SUBMITTED TO

SHIVAJI UNIVERSITY, KOLHAPUR

FOR THE DEGREE OF

MASTER OF SCIENCE

IN

ORGANIC CHEMISTRY

UNDER THE FACULTY OF SCIENCE AND TECHNOLOGY

BY

Miss. Pujari Kirti Chenna, Miss. Chikane Siddhi Ramesh,

Miss. Bagwan Shahista Hasan,Miss. Thorave Priyanka Dinesh, (B.Sc.)

UNDER THE GUIDANCE OF

Miss. Jaigude P. S.M. Sc.

DEPARTMENT OF CHEMISTRY,

KISAN VEER MAHAVIDYALYA, WAI

WAI – 412803, DIST. SATARA, (MS), INDIA.

APRIL 2025

JANATA SHIKSHAN SANSTHA'S

KISAN VEER MAHAVIDYALAYA, WAI

DEPARTMENT OF CHEMISTRY

Certificate

This is to certify that the project report entitled **"SYNTHESIS AND ANTIMICROBIAL ACTIVITIES OF AZO DYES INCORPORATING HETEROCYCLICS"** submitted by **Miss. Pujari Kirti Chenna, Miss. Chikane Siddhi Ramesh, Miss. Thorave Priyanka Dinesh, Baghwan Shahista Hasan** in fulfilment of the research project work, prescribed by **SHIVAJI UNIVERSITY, KOLHAPUR** for M.Sc. course in organic chemistry have been completed satisfactorily under my guidance year 2024- 2025.

Place: Wai

Date: 11/04/2025

11/04/2025

Miss. P. S. JAIGUDE

(Research Guide)

Prof. (Dr). D. N. Zambare

Head, Department of Chemistry

Professor and Head
Department of Chemistry
Kisan Veer Mahavidyalaya, Wai

External Examiner

Shivaji University, Kolhapur

DECLARATION

We hereby declare that the project entitled "**SYNTHESIS AND ANTIMICROBIAL ACTIVITIES OF AZO DYES INCORPORATING HETEROCYCLICS**" written by me under the guidance of **Miss. P. S. JAIGUDE** is our original work. The empirical findings presented in this report are based on experimental work carried by us during the course of the research project work.

Place: Wai

Date: 11/04/2025

Sr.	Name of Student	Roll No.	Seat No.
1	Pujari Kirti Chenna	19	2995
2	Chikane Siddhi Ramesh	25	2989
3	Thorave Priyanka Dinesh	24	3011
4	Baghwan Shahista Hasan	18	3012

ACKNOWLEDGEMENT

I am very glad to take this opportunity to express my gratitude to **Miss. P. S. JAIGUDE**, who kindly allowed us to do work under his guidance. She guided and helped me in every step of this research project work. She has been a constant encouragement to complete this research project work and given his excellent guidance and invaluable suggestions from this time during this work.

We would also like to express, special thanks to my Principal **(Dr) Gurunath J. Fagare, and Prof. (Dr) D. N. Zambare** Head Department of Chemistry for giving us a golden opportunity to do our project and giving facilities. Without whose help I may not be to complete this research project work properly.

Sr.	Name of Student	Roll No.	Sign
1	Pujari Kirti Chenna	19	
2	Chikane Siddhi Ramesh	25	
3	Thorave Priyanka Dinesh	24	
4	Baghwan Shahista Hasan	18	

INDEX

ABSTRACT

Consumers are becoming more picky about clothing quality these days, and the textile industry is seeing a rise in interest in creating environmentally responsible coloring techniques. The polyphenolic chemicals from a natural source were employed to create the widely used azo dye in this study. Acacia catechu's polyphenolic chemicals are utilized in the diazotization procedure, and FTIR verified that a dye with an azo group was formed. the antimicrobial properties of a natural dye, revealing notable efficacy against Candida and Staphylococcus species. The findings suggest its potential application as a natural antimicrobial agent in various formulations, including herbal cosmetics, antimicrobial textile dyes, and natural medicine. Further research and validation are necessary to fully explore its viability and applications.

INTRODUCTION

Because of its wide range of applications in advanced organic synthesis, microbiology, pharmaceuticals, medicine, industry, textile dyeing, and biomedicine, azo dye synthesis with a heterocyclic moiety has been gaining more and more attention. [1-2] Azo dyes are the most significant synthetic colorants that are used extensively in the production of textiles, printing, and paper. [3]

Azo dye of Heterocyclic compounds are very much important class of chemical constituent having large application in multiple fields such as polymer paper and coating industries as dying pigment. The activity of azo linkage (-N=N-) can be increase by incorporation of suitable heterocyclic moiety. According to report azo dye containing thiazole and oxazole have fascinated.

Azo dyes are intermediate for preparation of some application such as chemical activity. Azo dyes represent the largest production volume of dye chemistry today and their importance may even increase in future.

The synthesis of heterocycle-incorporated azo dye derivatives is now of great interest as a possible scaffold in the field of pharmacology. It has been noted that azo dyes with nitrogen and sulfur in their rings have attracted a lot of attention in the area in the last year. The bioactive qualities of the azo dye scaffold have been enhanced by the addition of thiazole and oxazole moiety. [4]

Because of their wide range of properties, including antibacterial properties,

the synthesis of heterocycles containing azo dye and its derivatives has attracted interest. anti-diabetic[5] , anti-inflammatory[6], anti-fungal, anti -oxidant[7] anti-viral, anti-convulsant,[8] anti-tubercular, anti-cancer[9], DNA binding, analgesic properties and chemo sensing activity. They have been used in a wide range of applications, including jet printing, biomedical fields, molecular recognition, light-controlled polymers, and the liquid crystal sector, in addition to being colorants in more than 50% of all commercial dyes. [10]

Because of its wide range of actions, chemists are inspired to create azo dyes with heterocyclic moiety. The report is still insufficient even though heterocycles with azo dye derivatives generally aid in pharmaceutical and therapeutic development.

Therefore, taking into account the various significance of heterocycle-incorporated azo dye, we have been motivated to create an azo dye with a heterocyclic moiety that is produced utilizing a natural catalyst.

LITERATURE & SURVEY

1. Manuel I. Velasco[11] et al reported synthesis of azo compound in acetonitrile using different nitrates as sources of nitrosonium ion to obtain diazonium salts.
2. Tawfik A. Khattab [12] et al reported synthesis of 3,6-Bis(arylazo)pyrazolo[1,5-a]pyrimidin 7-ylamine by using 3 method from 2-(phenylhydrazono)-3-oxo-propionitriles and 4-(arylazo)-2H-pyrazol-3-ylaminen with acetic acid or hydrazine hydrate or aniline derivative which shows anti-bacterial activity.
3. Bahador Karami[13] et al reported synthesis of azo coumarin dyes by using 7-amino coumarins with naphthols, coumarins, and phenols with molybdate sulfuric acid.
4. M. R. Yazdanbakhsh[14] et al reported and synthesized 4-hydroxy coumarin azo dyes by coupling 4-hydroxy coumarin with a diazonium salt.
5. Shanmugam Prakash[15] et al reported the novel bioactive azo compounds fused with benzothiazole in which 2-amino benzothiazole was coupled with various synthetic phenolic antioxidant molecules like BHA, phloroglucinal, 2,4-di–tert-butylphenol and 2,6-di–tert-butylphenol.
6. H.F. Rizk[16] et al reported synthesis of sodium 6-(4,6-dichloro-1,3,5-triazin-2-ylamino)-8-((1 phenyl-3-substituted-1H-pyrazol-4-yl)diazenyl)-7-hydroxynaphthalene-2 sulfonates from 5-Amino-3-substituted-1-phenylpyrazoles with Nitrosyl sulphuric acid and sodium nitrite which shows

antibacterial and anti-fungal activities.

7. Hari R. Maradiya[17] et al reported synthesis of 5-acetyl-2-[4-[N-(2-hydroxyethy)amino] phenylazo]- 4-methylthiazole by using various N-alkyl derivatives of aniline with propionic acid and AcOH.
8. C. K. Atay[18] et al reported synthesis of 3-methyl-5-(1 methyl-1H-imidazol-2-yl)diazenyl)-4-aryldiazenyl) 1H-pyrazole from 5-amino-4-arylazo-3-methyl-1H-pyrazoles and 2-aryhydrazone-3-ketiminobutyronitriles by using diazonium salt, nitrosyl sulfuric acid, and glacial acetic acid/propionic acid which shows Antimicrobial activities.
9. Azal S. Waheeb[19] et al reported synthesis of 2-[2- (4,5-Dimethyl thiazolyl)azo]- 4-methoxy phenol (DMeTAMP) from 2 amino-4,5-dimethyl thiazol coupling with 4-methoxy phenol and using sodium nitrite which shows antimicrobial activity.

OUR WORK

In modern organic chemistry improvement of reaction efficiency the avoidance of reagent the reduction of waste and the responsible utilization of our resource have become critical objective By keeping these idea in mind a simple and protocol for the synthesis of azo dye derivative has been developed by a diazotization and coupling of amino-thiazole and catechin.

In view of above consideration, our interest in the azo dyes. Principally from work undertaking with amino-thiazole and catechin as a solvent and ice-cold temp. condition are through to afford the product nearly quantitative yield.

Here I report an extremely facile and environmentally friendly method for the preparation of azo dyes by the simple use of amino-thiazole and catechin. General diazotization and coupling reaction route is slightly synthetic, rather than a greener one.

Catechin Power

EXPERIMENTAL SECTION

SAFETY

Personal protective equipment including safety goggles, gloves and a lab coat must be worn at all times during the experiment. Long pants should be worn along with close-toed shoes. No food or drink is allowed in the lab. Always work in the fume hood. Be careful when handling the products, they are deeply coloured and will stain your skin and cloth for a long period of time. Do not wipe gloves on lab coats.

Collection of Raw Materials:

Amino-Thiazole, hydrochloric acid, distilled water sodium nitrite and sodium hydroxide were purchased from Swaraj Chemical, Pune and used without any further purification. Acacia catechu powder was collected from the local market.

PROCEDURES

Diazotization and coupling reaction between amino-thiazole and catechin carried out in ice bath. Reaction is monitored by TLC. Recrystallize the product and Characterized by IR.

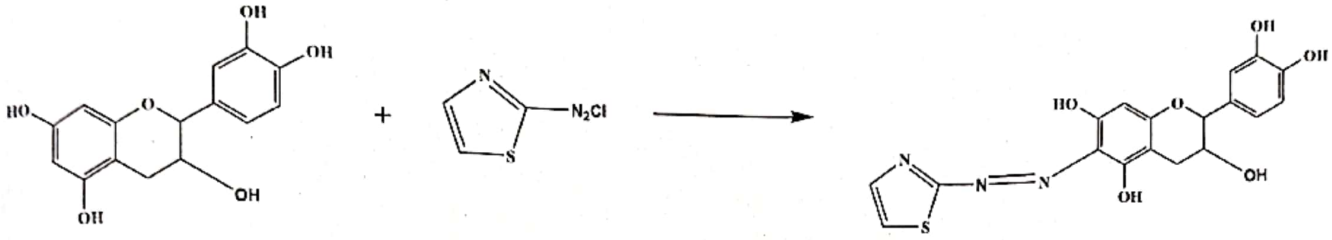
General Procedure

Diazotization reaction:

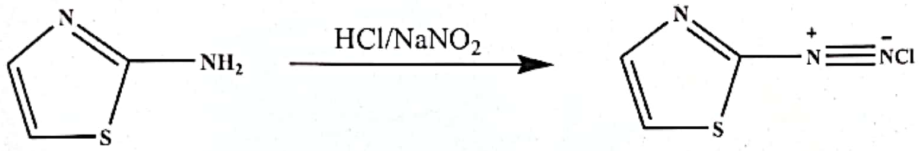
Amino-thiazole and concentrated HCl were added in a beaker and cooled on an ice bath for half an hour. Previously cooled 4% $NaNO_2$ solution was added slowly to the beaker with continuous stirring for the formation of diazonium salt. In another beaker, raw Acacia catechu powder was dissolved in 0.1M NaOH solution and cooled in ice bath. The insoluble materials were separated from the solution through filtration. After that the solution of Acacia catechu was slowly added to the beaker of diazonium salt keeping in an ice bath.

Reaction and Mechanism

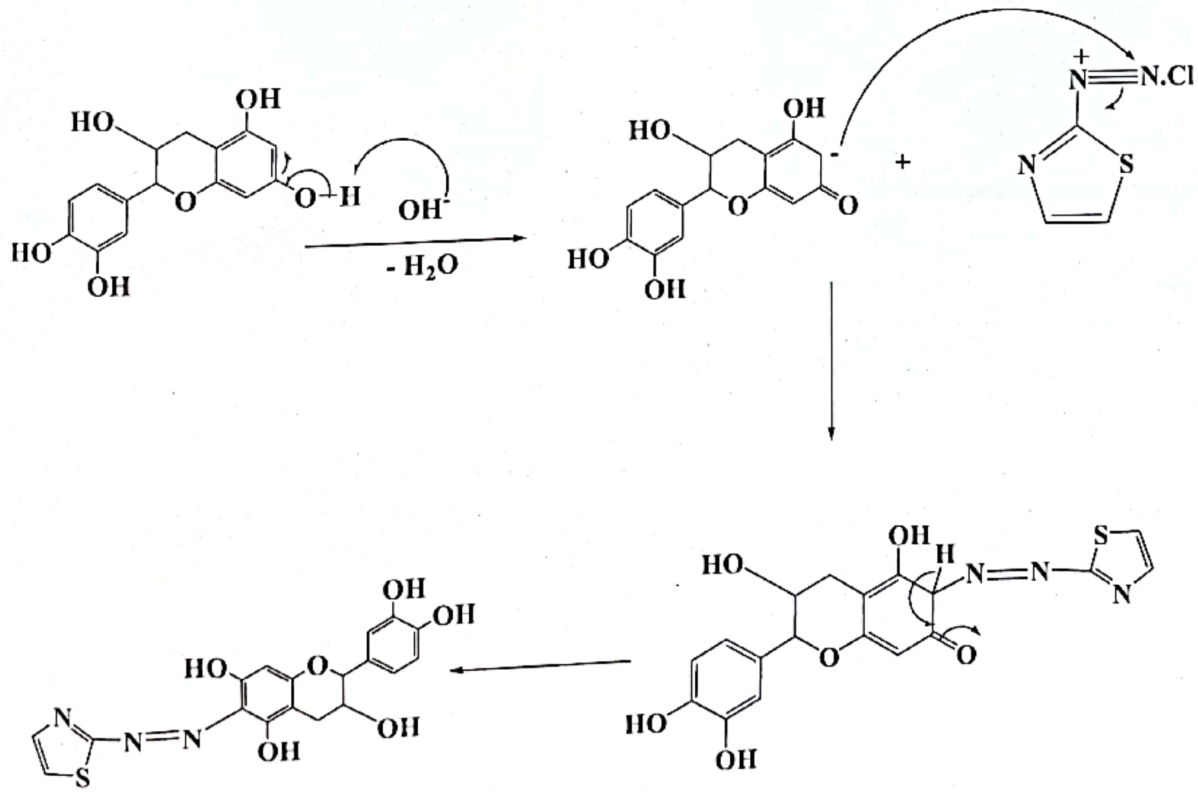
Reaction of Thiazole and Catechin

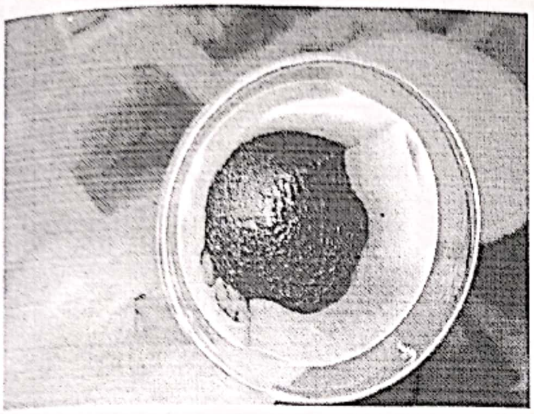


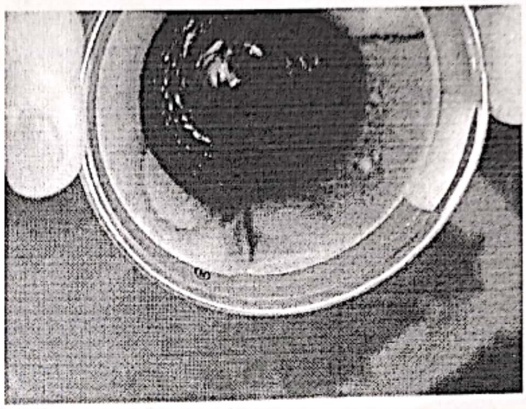
Step I) Diazotization of Thiazole

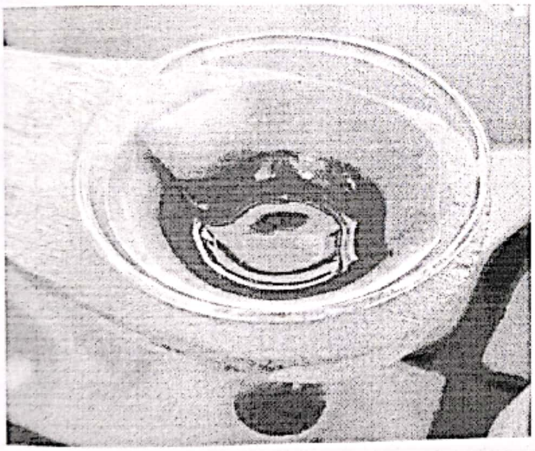


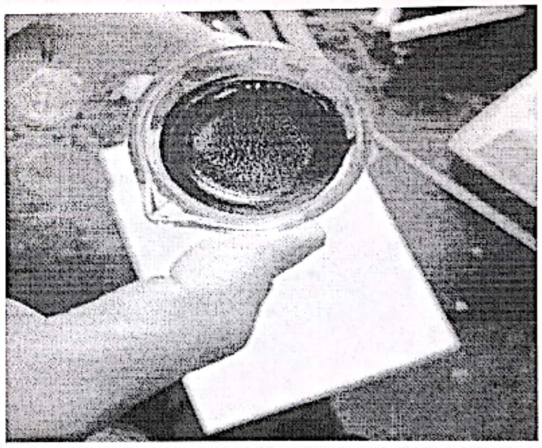
Step II) Coupling of Thiazole and Catechin











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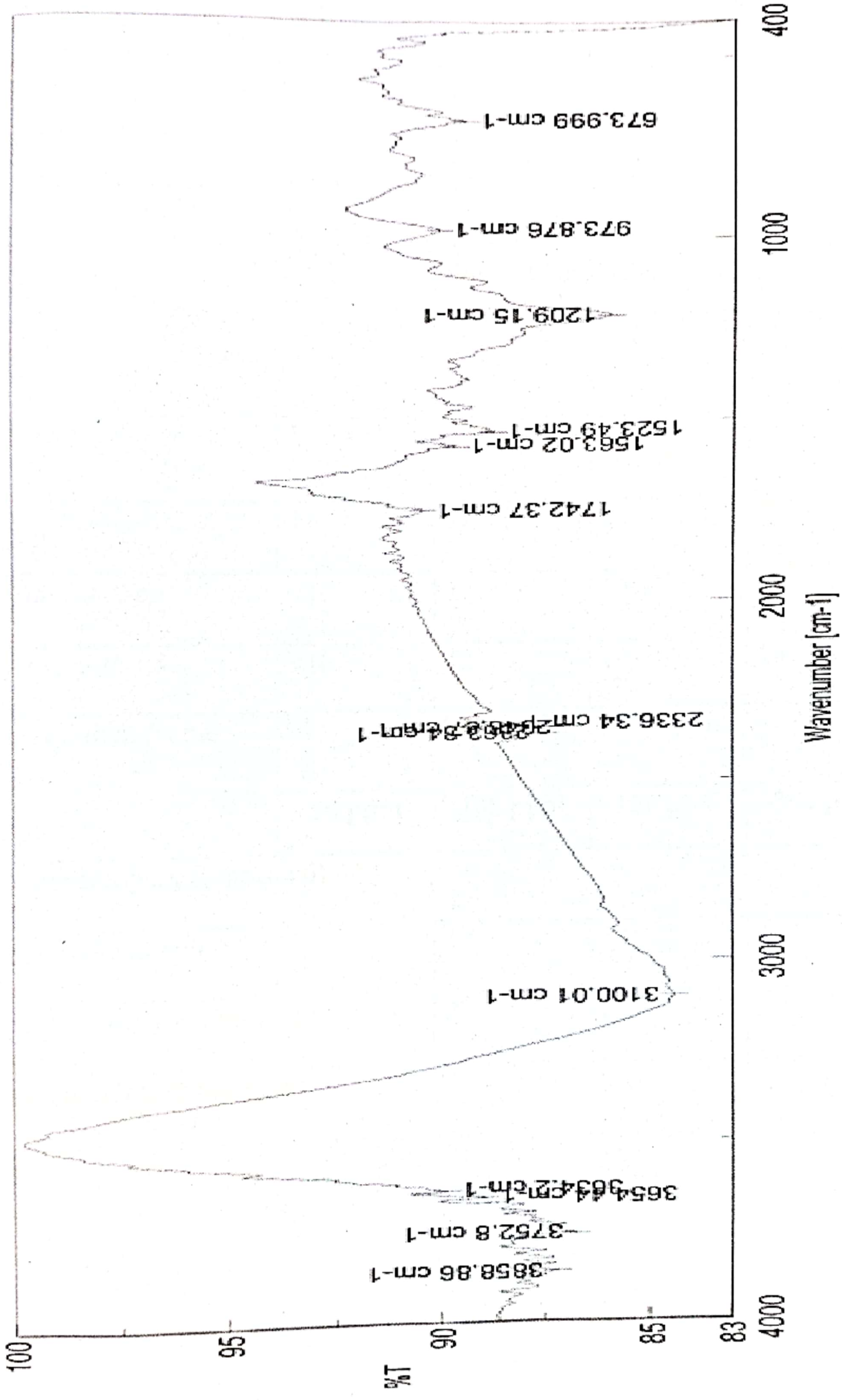
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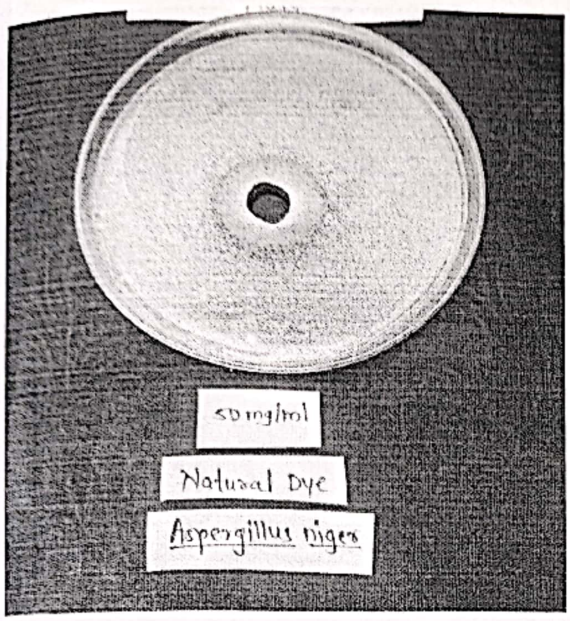
3100.01 cm-1
3752.8 cm-1
3858.86 cm-1
%T
100
95
90
85
83
4000
3000
2000
1000
400
Wavenumber [cm-1]

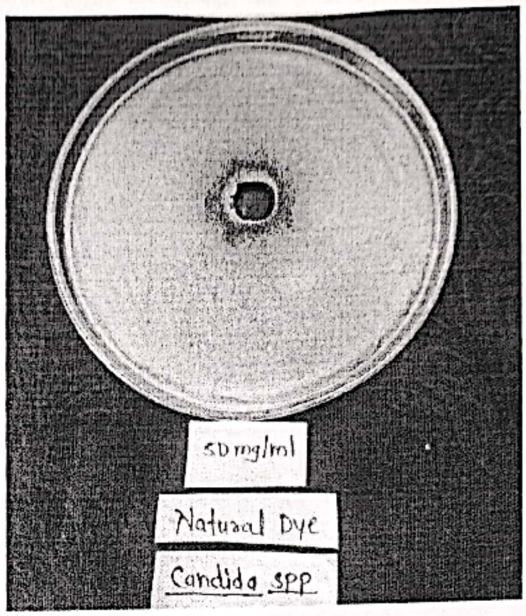
Antimicrobial Activity

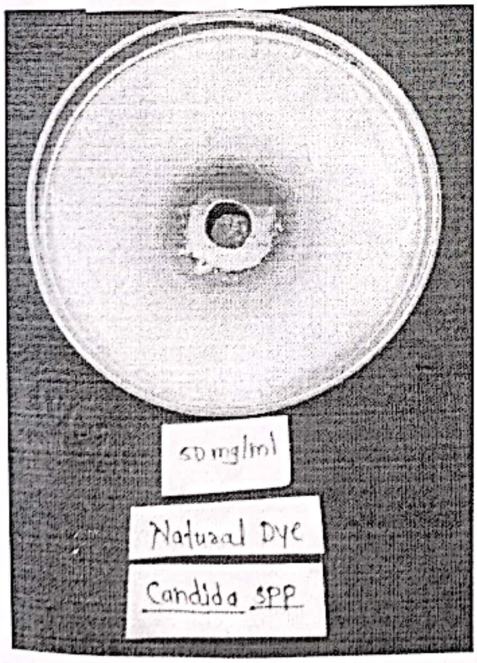
Antimicrobial Activity by Well Diffusion Method

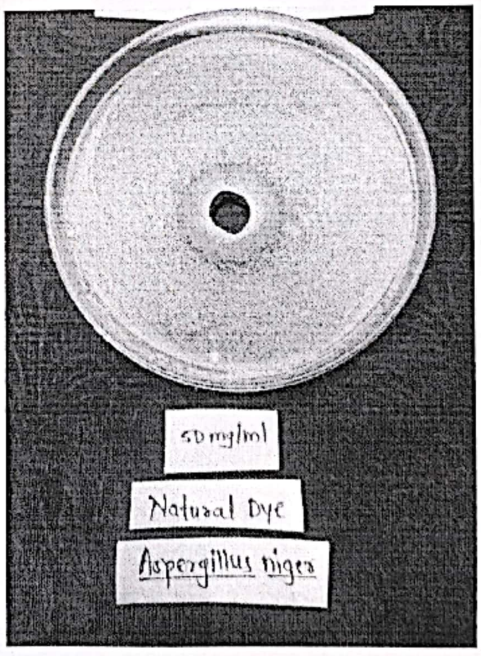
Sr.	Organism Name	Zone of Inhibition (mm)			
		10 mg/ml	15 mg/ml	25 mg/ml	50 mg/ml
1.	*Escherichia coli*	12	13	15	23
2.	*Staphylococcus Spp.*	11	22	24	26
3.	*Candida Spp.*	<10	14	16	20
4.	*Aspergillus Spp.*	<10	12	19	24
Sr.	**Organism Name**	**Zone of Inhibition (mm)**			
		50 ppm	**100 ppm**	**150 ppm**	**300 ppm**
	Streptomycin (Standard)				
1.	*Escherichia coli*	12	13	14	15
2.	*Staphylococcus Spp.*	20	22	24	20
	Fluconazole (Standard)				
3.	*Candida Spp.*	15	21	26	30

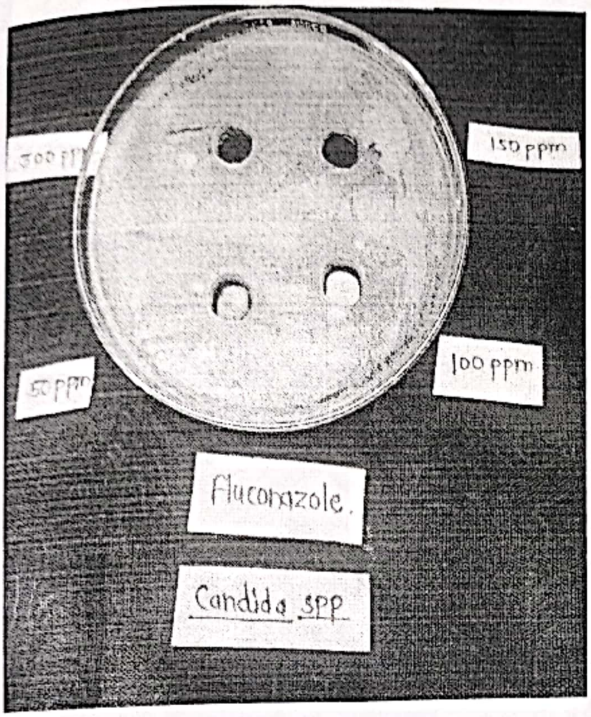
Anti-Fungial

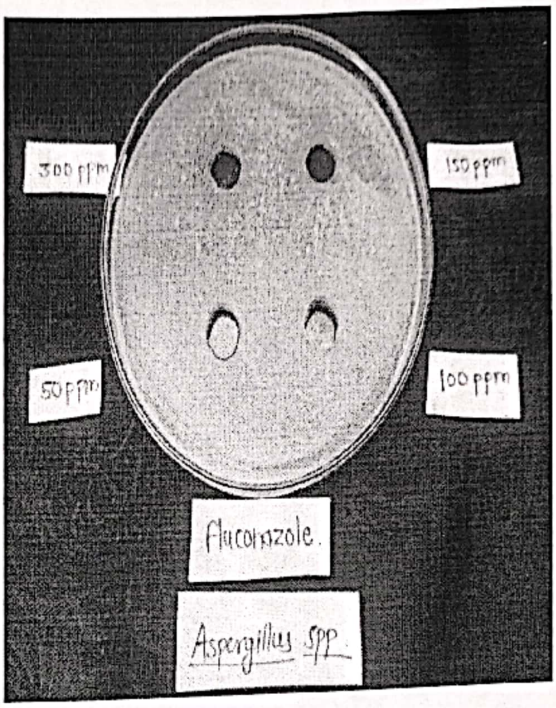




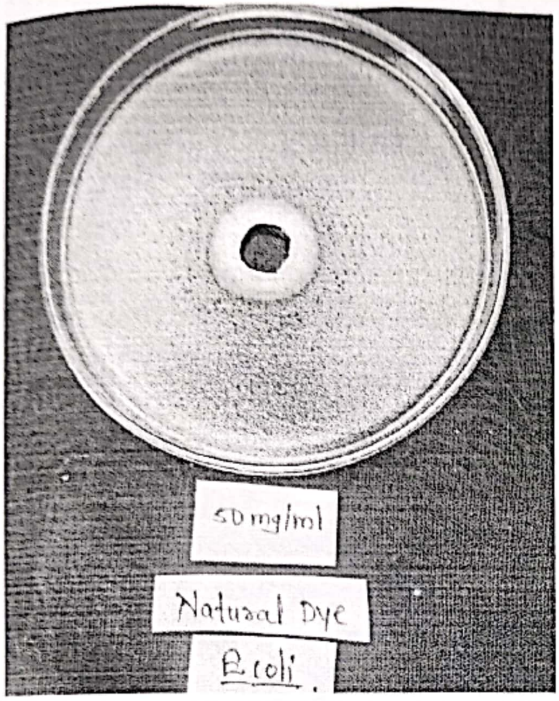


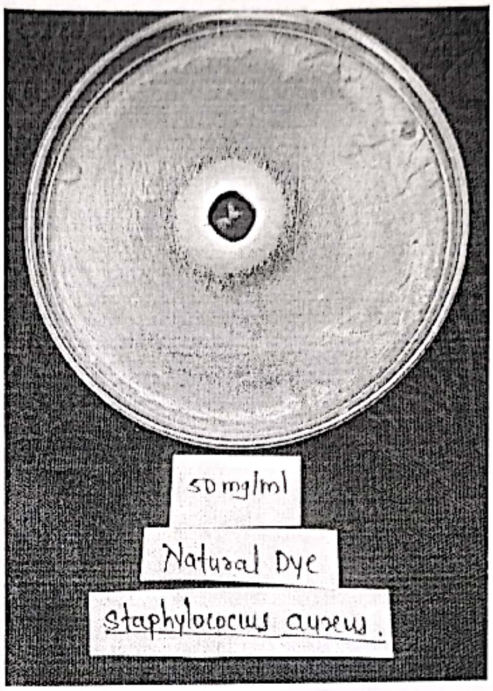


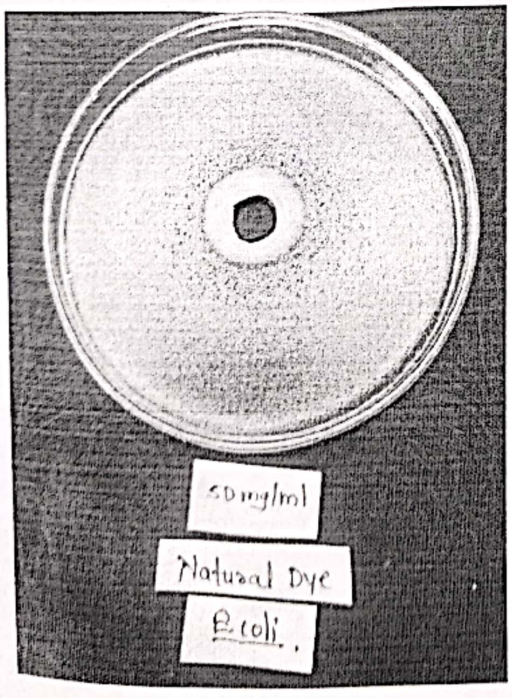


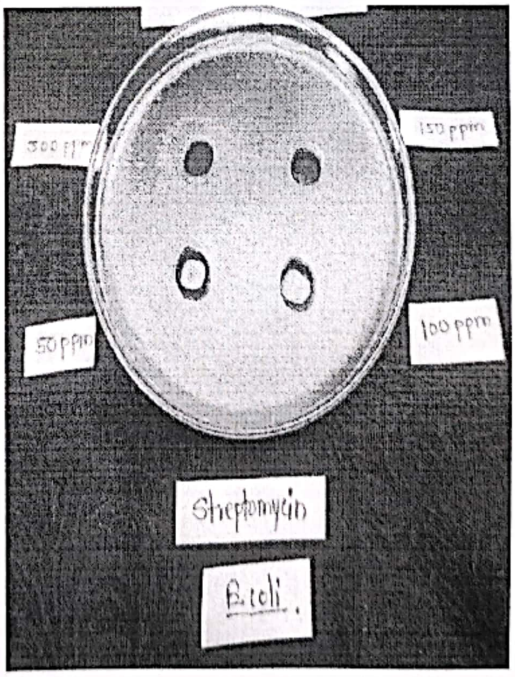


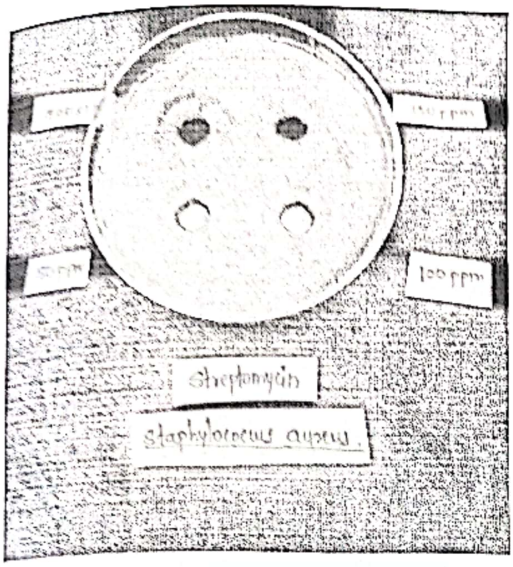
Anti-bacterial

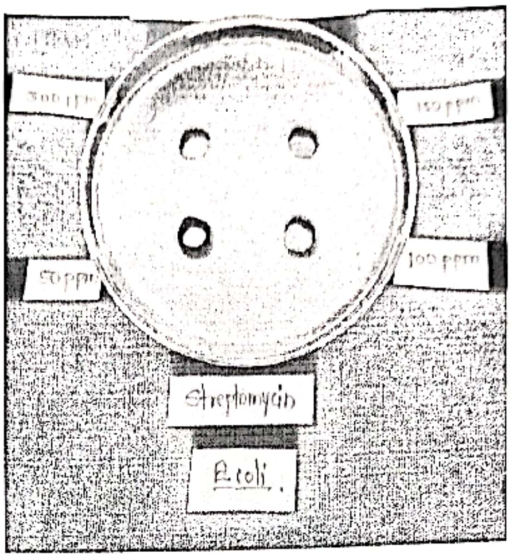












The tested **Natural Dye** has **notable antimicrobial properties**, especially against **Candida and Staphylococcus** species. Its **potential use as a natural antimicrobial agent** may be viable in formulations like herbal cosmetics, textile dyes with antimicrobial properties, or even natural medicine — subject to further testing and validation.

RESULT AND DISCUSSION

The diazotization and coupling of amino-Thiazole with catechin. It is further purified, recrystallized and studied the IR Spectrum of dyes which gives information about functional group incorporated in the product or dye.

Antimicrobial Activity Results

Measured as **Zone of Inhibition (in mm)** — Larger values indicate stronger antimicrobial activity.

Test Sample

Sr.	Organism Name	Zone of Inhibition (mm)			
		10 mg/ml	**15 mg/ml**	**25 mg/ml**	**50 mg/ml**
1.	*Escherichia coli*	11 mm	12 mm	14 mm	17 mm
2.	*Staphylococcus Spp.*	11 mm	12 mm	16 mm	20 mm
3.	*Candida Spp.*	10 mm	14 mm	18 mm	23 mm
4.	*Aspergillus Spp.*	<10 mm	<10 mm	<10 mm	<10 mm
Standard Comparisions					
Standard (Control)		**50 ppm**	**100 ppm**	**150 ppm**	**300 ppm**
	Streptomycin (for bacteria)				
1.	*E. coli*	12 mm	13 mm	14 mm	15 mm
2.	*Staphylococcus spp.*	20 mm	22 mm	24 mm	27 mm
	Fluconazole (for fungi)				
3.	*Candida Spp.*	15	21	26	30

Interpretation

- The **Natural Dye** sample exhibits **moderate antimicrobial activity**, especially at higher concentrations (50 mg/ml).
- The effect is **strongest against *Candida spp.* and *Staphylococcus spp.***.
- **No significant inhibition observed against *Aspergillus spp.*** (all
- values <10 mm).
- Compared to standard drugs:

1. The dye performs reasonably well against *Candida* and *Staphylococcus* at high concentrations.
2. It is **less effective than standards**, but still shows **promising antimicrobial potential**, especially as a natural product.

CONCLUSION

Azo dye was prepared by using the natural polyphenolic compounds of Acacia catechu through diazotization reaction. Formation of dye containing the azo group was confirmed by FTIR. The tested natural dye has significant antimicrobial qualities, particularly against Staphylococcus and Candida species. With additional testing and validation, it could be used as a natural antimicrobial agent in formulations such as herbal cosmetics, textile dyes with antimicrobial qualities, or even natural medicine.

REFERENCE

1. Tahir, T., Ashfaq, M., Saleem, M., Rafiq, M., Shahzad, M.I., Kotwica-Mojzych, K. and Mojzych, M., 2021. Pyridine scaffolds, phenols and derivatives of azo moiety: current therapeutic perspectives. *Molecules*, *26*(16), p.4872.

2. Sahilu, R., Eswaramoorthy, R., Mulugeta, E. and Dekebo, A., 2022. Synthesis, DFT analysis, dyeing potential and evaluation of antibacterial activities of azo dye derivatives combined with in-silico molecular docking and ADMET predictions. *Journal of Molecular Structure*, *1265*, p.133279.

3. El Harfi, S. and El Harfi, A., 2017. Classifications, properties and applications of textile dyes: A review. *Applied Journal of Environmental Engineering Science*, *3*(3), pp.00000J-Envir

4. Mezgebe, K. and Mulugeta, E., 2022. Synthesis and pharmacological activities of azo dye derivatives incorporating heterocyclic scaffolds: a review. *RSC advances*, *12*(40), pp.25932-25946.

5. Singh, K., Pal, R., Khan, S.A., Kumar, B. and Akhtar, M.J., 2021. Insights into the structure activity relationship of nitrogen-containing heterocyclics for the development of antidepressant compounds: An updated review. *Journal of Molecular Structure*, *1237*, p.130369.

6. Patil, C.J., Talele, D.S., Talele, S.P., Pohekar, P.R. and Kolhe, D.S., 2019. Coupling Reactions Involving Aryldiazonium Salt: Part-VII. Products of

Chemoselective Reaction of Aryldiazonium Chloride with Active Methylene Group containing Moiety. *Journal of Pharmaceutical Sciences and Research*, *11*(6), pp.2213-2219.

7. Mi, Y., Zhang, J., Han, X., Tan, W., Miao, Q., Cui, J., Li, Q. and Guo, Z., 2021. Modification of carboxymethyl inulin with heterocyclic compounds: Synthesis, characterization, antioxidant and antifungal activities. *International Journal of Biological Macromolecules*, *181*, pp.572-581.

8. Singh, K., Pal, R., Khan, S.A., Kumar, B. and Akhtar, M.J., 2021. Insights into the structure activity relationship of nitrogen-containing heterocyclics for the development of antidepressant compounds: An updated review. *Journal of Molecular Structure*, *1237*, p.130369.

9. Al-Adilee, K.J. and Hessoon, H.M., 2019, July. Synthesis, spectral properties and anticancer studies of novel hetrocyclic azo dye ligand derived from 2-amino-5-methyl thiazole with some transition metal complexes. In *Journal of Physics: Conference Series* (Vol. 1234, No. 1, p. 012094). IOP Publishing.

10. Benkhaya, S., M'rabet, S. and El Harfi, A., 2020. Classifications, properties, recent synthesis and applications of azo dyes. *Heliyon*, *6*(1).

11. Velasco, M.I., Kinen, C.O., De Rossi, R.H. and Rossi, L.I., 2011. A green alternative to synthetize azo compounds. Dyes and Pigments, 90(3), pp.259-264.

12. Khattab, T.A., Elnagdi, M.H., Haggaga, K.M., Abdelrahmana, A.A. and Aly, S.A., 2017. Green synthesis, printing performance, and antibacterial activity of

disperse dyes incorporating arylazopyrazolopyrimidines. AATCC Journal of Research, 4(4), pp.1-8.

13.Karami, B. and Kiani, M., 2017. Green synthesis of novel class of azo dyes based on naphthols, coumarins, and phenols with molybdate sulfuric acid. Polycyclic Aromatic Compounds, 37(4), pp.257-266.

14.Yazdanbakhsh, M.R., Ghanadzadeh, A. and Moradi, E., 2007. Synthesis of some new azo dyes derived from 4-hydroxy coumarin and spectrometric determination of their acidic dissociation constants. Journal of Molecular Liquids, 136(1-2), pp.165-168.

15.Prakash, S., Somiya, G., Elavarasan, N., Subashini, K., Kanaga, S., Dhandapani, R., Sivanandam, M., Kumaradhas, P., Thirunavukkarasu, C. and Sujatha, V., 2021. Synthesis and characterization of novel bioactive azo compounds fused with benzothiazole and their versatile biological applications. Journal of Molecular Structure, 1224, p.129016.

16.Rizk, H.F., Ibrahim, S.A. and El-Borai, M.A., 2015. Synthesis, fastness properties, color assessment and antimicrobial activity of some azo reactive dyes having pyrazole moiety. *Dyes and Pigments*, *112*, pp.86-92.

17.Maradiya, H.R. and Patel, V.S., 2001. Synthesis and dyeing performance of some novel heterocyclic azo disperse dyes. *Journal of the Brazilian Chemical Society*, *12*, pp.710-714.

18.Karabacak Atay, Ç., Gökalp, M., Tuncer, B.Ö. and Tilki, T., 2017. Antimicrobial activities and absorption properties of disazo dyes containing

imidazole and pyrazole moieties. *Journal of Macromolecular Science, Part A*, *54*(4), pp.236-242.

19. Ghasemi, Z., Azizi, S., Salehi, R. and Kafil, H.S., 2018. Synthesis of azo dyes possessing N-heterocycles and evaluation of their anticancer and antibacterial properties. *Monatshefte für Chemie-Chemical Monthly*, *149*, pp.149-157.