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DVV Metric No.: 1.3.2.1QnM: Number of Students Undertaking Project Work/Field Work/Internships.

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No. Sc. .....

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SEAL

Metric No.: 1.3.2.1QnM: Number of Students Undertaking Project Work/Field Work/Internships.

2023-2024			
Project Work	Field Work	Internship/On-job Training	Total
497	158	130	785

DVV Findings:

Value has been updated as one student involved in multiple field works/internship in the same academic session will be count as one

HEI Needs to provide project report, internship completion certificate/project work completion certificate from organization from where the internship/project was completed of the following students.

1.Sakshi Nale M.Sc (Physics) (Project work)

2. Nimmi Kumbhare M.Sc (Microbiology) (Project work)

3. Mohadikar Akshita Pushparaj (B.Sc-II) EVS Project

4. Pawade Pradnya Purushottam (B.Sc-II) EVS Project

5. Summati Kale (Field Work) (Geology)

6. Sayali Kamble, (Field Work) (Geology)

7. Sayali Kamble, (Field Work) (Botany)

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A project report on

"COMPARATIVE STUDY FOR IMPACT OF DIFFERENT SYNTHESIS APPROACHES ON STRUCTURAL AND OPTICAL PROPERTIES OF Ni-Zn NANOSTRUCTURED FERRITES"

Submitted to

R.T.M. Nagpur University Nagpur

In the partial fulfillment of the degree of

MASTER OF SCIENCE IN PHYSICS

By

Ms. Sakshi T. Nale

M. Sc. II (Physics)

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2023-2024

CERTIFICATE

This is to certify that **Ms. Sakshi T. Nale** has carried out project work entitled **"COMPARATIVE STUDY FOR IMPACT OF DIFFERENT SYNTHESIS APPROACHES ON STRUCTURAL AND OPTICAL PROPERTIES OF Ni-Zn NANOSTRUCTURED FERRITES"** under my supervision in the project program carried out during the academic year **2023-2024** towards partial fulfillment of the requirement prescribed for the **Master's Degree of Science** (M.Sc. Physics) of **Rashtrasant Tukadoji Maharaj Nagpur University,** Nagpur, in the faculty of Science and Technology.

Place: Nagpur

Date: 24/05/24

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DECLARATION

I, hereby, declare that the work presented in this Project Report on **"COMPARATIVE STUDY FOR IMPACT OF DIFFERENT SYNTHESIS APPROACHES ON STRUCTURAL AND OPTICAL PROPERTIES OF Ni-Zn NANOSTRUCTURED FERRITES"** has been carried out by me under the guidance of Dr. S.W. Anwane and Dr. Ragini Pathare, Department of Physics, S.S.E.S Amt's Science College Nagar, Nagpur.

The work presented in this dissertation, submitted for the award of the degree of Master of Science in Physics to Rashtrasant Tukadoji Maharaj Nagpur University, Nagpur, has not submitted to any other university or institution for the award of a degree or a diploma or certificate.

Place: Nagpur

Date: 24/05/24

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Ms. Sakshi T. Nale
M.Sc. IInd year Physics

CONTENT

CHAPTER 1

INTRODUCTION

1.1 NANOSCIENCE

The term "Nanoscience" itself was coined in the 1970s by Professor Norio Taniguchi. The word "nanoscience" comes from the Greek word "nanos" (or Latin "nanus"), which means "dwarf", and the word "science". Nanoscience is the study of processes and manipulation of the materials at atomic or molecular scale, such that the properties vary considerably than at larger scales i.e., bulk materials. Nanoscience is the study of structures and molecules on the nanometer scale, which is between 1 and 100 nanometers. The way molecules and atoms assemble on the nanoscale into larger structures determines important properties of materials, such as electrical, optical, thermal, and mechanical properties. In nanometer size structures, these properties often differ from those on the macroscale.

Nanoscience is a convergence of physics, materials science and biology, which deal with manipulation of materials at atomic and molecular scales. Nanoscience is the study of phenomena on a nanometer scale. Typically, nano means 10^{-9}. So, a nanometer is one billionth of a meter and is the unit of length that is generally most appropriate for describing the size of single molecule. Anyhow the rough definition of Nanoscience could be anything which has at least one dimension less than 100 nanometer [1].

1.2 NANOTECHNOLOGY

The term nanotechnology comes from the Greek word "nanos" that means "dwarf". Science uses this prefix to indicate 10 or one billionth. One nanometer one billionth meter that is about 100,000 times smaller than the diameter of a single human hair. Nanotechnology is the branch of science and engineering which deals with creation of materials, devices and systems through the manipulation of individual atoms and molecules. The goal of nanotechnology is to control the individual atoms and molecules to create computer chips and other devices that are thousands of times smaller than current technologies limit.

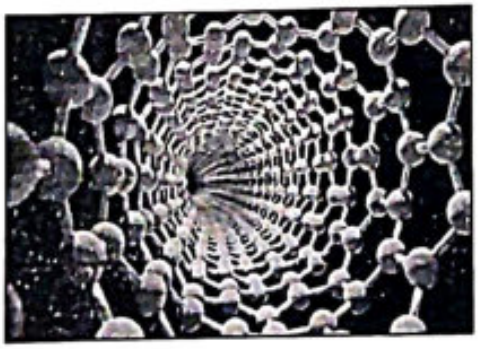
The technology that utilizes nanoscience in practical applications is called nanotechnology. Nanotechnologies include "nanoscale designing, characterizing, and producing structures, devices and systems by controlling shape and size for their applications in various fields". Nanotechnology and Nano science open up new of research and lead to new engines surface allow making products that perform better. The properties of materials differ in fundamental and valuable ways from the properties of individual atoms and molecules or bulk matter.[2]

1.3 NANOPARTICLES

Nanoparticles are tiny particles which have diameter between 1 to 100 nanometers and they found in various products like electronics, medicine and these particles are made from various materials such as metals ceramics or polymers. Nanoparticles have their unique properties due to their size and which makes them useful in different fields. Nanoparticles have special properties that regular particles don't have. Nanoparticles can be synthesized through various methods, such as chemical synthesis, physical vapour deposition, or even by breaking down larger materials into smaller particles. Scientists and engineers are continuously exploring new ways to create and utilize nanoparticles for a wide range of purposes.[3]

1.4 NANOMATERIALS

Nanomaterials are fascinating materials that exists at the nanoscale and which is very small and typically ranging from 1 to 100 nanometers. At this range, material exhibits unique properties. These properties are arises from the high surface area to volume ratio of nanomaterials which is allowing for increased reactivity, strength and other characteristics. The smaller something is the larger its surface area to volume ratio. If a bulk material is sub-divided into an ensemble of individual nano materials, the total volume remains the same, but the collective surface area is greatly increased. It means nano particles have increased surface to volume ratio compared to bulk materials. For example, for example, for a particle of 1 micrometer in diameter, nearly 0.15% of its atoms are on the surface, while for a particle of 6nm in diameter, nearly 20% of its atoms are on surface. The chemical group that are at the material interface determine its properties Like catalytic reactivity, electrical resistivity, adhesion, gas storage and chemical reactivity depend on the nature of interface. Nanomaterials have a significant proportion of atoms at the existing at the surface. Nanoparticles are one of the type of an nanomaterial. These special properties make nanomaterials stand out and valuable for various applications in medicine, electronics and energy sectors. [4]



1.5 MAGNETISM

Magnetism is a force of nature produced by moving electric charges. Sometimes these motions are microscopic and inside of a material known as magnets. Magnets, or the magnetic fields created by moving electric charges, can attract or repel other magnets, and change the motion of other charged particles.[5]

1.5.1 DIAMAGNETISM

Diamagnetic materials are those materials that are freely magnetized when placed in the magnetic field. However, the magnetization is in the direction opposite to that of the magnetic field. The magnetism that is shown by these materials is known as diamagnetism. Diamagnetic materials are substances that are usually repelled by a magnetic field. The permanent magnetic momentum in an atom of the diamagnetic material is zero. Diamagnetic properties arise from realignment of electron path under the influence of an external magnetic field. Diamagnetism is present in all materials and is independent of temperature but the effect is so weak it is often neglected in comparison to paramagnetic and ferromagnetic effects. Diamagnetic materials have a weak, negative susceptibility to magnetic field. Some of the most common examples of diamagnetic substances are Copper, Zinc, Bismuth, Silver, Gold, Antimony, Marble, Water, Glass, etc..[6]

1.5.2 PARAMAGNETISM

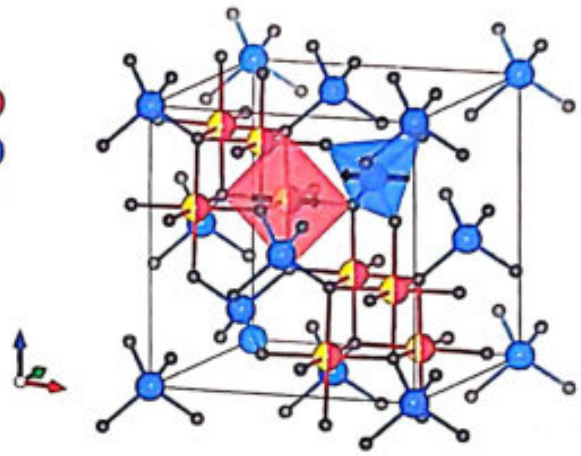
Paramagnetic materials are materials that tend to get weakly magnetized in the direction of the magnetizing field when placed in a magnetic field. Paramagnetic materials have a permanent dipole moment or permanent magnetic moment. However, if we remove the applied field the materials tend to lose their magnetism. These materials usually experience a weak attraction to magnets. This type of magnetism is known as paramagnetism. It occurs mainly due to the presence of unpaired electrons in the material or due to the partial alignment of randomly oriented atomic dipole along the field. When the net atomic dipole moment of an atom is not zero, the atoms of paramagnetic substances have permanent dipole moment due to unpaired spin. Magnetic susceptibility is small and positive. Some of the examples of paramagnetic materials include iron oxide, oxygen, titanium, aluminium, transition metal complexes, etc.

CHAPTER 2

INTRODUCTION TO FERRITES

- FERRITES

The term ferrite is derived from a Latin word "ferrum" meaning iron oxides which finds potential applications for making many devices such as permanent magnets, memory storage devices, and for the telecommunication purpose. Ferrites are the magnetic material with ferromagnetic ordering having iron as the principle component of its composition. Iron which is present in the form of iron oxide in nature has pure phases such as Magnetite (Fe_3O_4), Hematite (Fe_2O_3), Iron oxide beta phase; Maghemite etc. these compounds have properties like trivalent oxidation state, distinct color and low solubility. The most important ferrite is magnetite (Fe_3O_4) which contains both Fe^{2+} ion and Fe^{3+} ion. Ferrites are basically the class of magnetic nanoparticles which are the derivatives of magnetite and hematite as well as other oxides of metals. The growing interest in ferrites is due to their spontaneous magnetization. In the absence of the applied magnetic field, high permeability, low magnetic losses, high electrical resistivity, low eddy current losses, good thermal and chemical stability, biological compatibility, relative ease of preparation and number of applications in various fields.[9]



In 1930, Yogoro Kato and Takeshi Takei Spinel Ferrite Nanostructures for Energy Storage Devices reported the first ferrite compound in the Tokyo Institute of Technology. Ferrites canbe obtained in three different crystal systems by various synthesis methods, and the flexibility to prepare the unlimited number of solid solutions compositions to tailor their properties for myriad applications.

- NANOFERRITES

Nanoferrites are a type of ferrites that have been engineered at the nanoscale. They have unique properties due to their small size. These nanomaterials have enhanced magnetic properties compared to regular ferrites, making them useful in applications like data storage and high-frequency devices. They can also have other interesting properties like enhanced catalytic activity and biomedical applications. They have many applications in medicine and technology. Nanoferrites can be synthesized at the nanoscale using various methods, such as sol-gel, auto-combustion, co-precipitation, or hydrothermal techniques. These methods allow scientists to precisely control the size, shape, and composition of the nanoferrite particles.

Nanoferrites have been the up-and-coming focus of attention of recent scientific research both from a synthesis and an application perspective. The properties of nanoferrites are very sensitive to the method of preparation and the sintering condition. Therefore, the selection of an appropriate process is the key to obtaining high-quality ferrites.

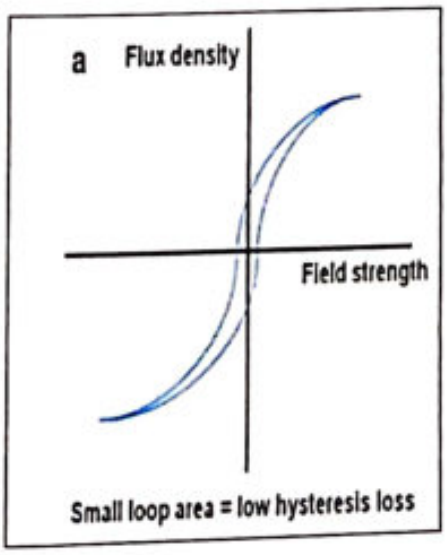
2.1 Classification on basis of magnetism

Ferrites can be classified according to crystal structure that is, cubic vs. hexagonal ferrite or magnetic behavior; that is, soft vs. hard ferrite. Soft ferrites are easy to magnetize and demagnetize. Hard ferrites are hard to magnetize and demagnetize. Hard magnetic materials are commonly used for permanent magnetic applications.

2.1.1 Soft Ferrites

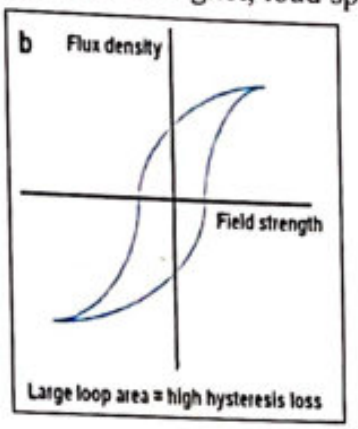
Soft ferrites have low coercivity, so they easily change their magnetization and act as conductors of magnetic fields. They are typically composed of iron oxide and other metal oxides such as nickel, zinc, or manganese. These ferrites have a high magnetic permeability and low coercivity, which means they are susceptible to demagnetization. This property makes them ideal for use in high-frequency applications such as transformers, inductors, and other electronic components. Soft ferrites are also used in magnetic shielding applications, where they can help to reduce magnetic interference. Soft ferrites are not permanent magnets. They carry magnetism like mild steel but as soon as the magnetic field is removed, the magnetism disappears. Soft ferrites are popular as transformers to change the voltage from primary to secondary windings. So soft ferrites are often called transformer ferrites.[10]

There are several kinds of soft ferrites. Manganese-Zinc ferrites are the most common type of soft ferrites, which are employed to make power, shielding, and linear inductive components. Nickle-Zinc ferrites have outstanding resistivity. Ferrites that are used in transformer or electromagnetic cores contain nickel, zinc, or manganese compounds.[11]



2.1.2 Hard Ferrites

Hard ferrites are also known as permanent magnetic materials because they can hold their magnetism after being magnetized. Hard ferrites are those ferrimagnetic materials which havegradually rising magnetization curve, large hysteresis loop and large energy losses during magnetisation. Hard ferrites can be produced by heating and sudden cooling and cannot be easily magnetized and demagnetized. Hard ferrites are compound of iron and barium or strontium oxides. Hard ferrites have high saturation flux density, low susceptibility and permeability, high eddy current losses, and high retentivity and coercivity. Therefore, hard ferrites are used in permanent magnet, DC magnet, loud speakers, etc. [12].



2.2 Classification on basis of crystal structure

In most of the research work done on ferrites, scientists classify the ferrites according to their crystal structure. Hence, there are four important types of ferrites: spinel ferrites, garnet ferrites, ortho ferrites, and hexaferrites.

2.2.1 Spinel Ferrite

The general structural formula of a spinel ferrite can be written as MFe_2O_4, where M stands for the divalent metal ion like, Fe, Co, Ni, Mn, Mg, Cu and Zn, etc. or a combination of these ions. The spinel structure belongs to space group Fd3m. The unit cell of spinel ferrite is face-centered cubic (f.c.c) with eight formula units per unit cell ($M_8Fe_{16}O_{32}$).[13] Based on crystal structure, spinel can be categorized into three types, that is, normal spinel, inverse spinel and complex spinel. For normal spinel, M (II) and Fe (III) occupy at tetrahedral and octahedral sites respectively, and $ZnFe_2O_4$ is a typical example of normal spinel. Usually, the interstices of octahedral sites are larger than that of tetrahedral sites, so the cations at smaller radius are inclined to locate at the M sites while the cations at larger radius are inclined to locate at the Fe (III) sites. While for inverse spinel, half of the Fe (III) locates at tetrahedral sites, and the M (II) along with the other half Fe (III) locates at octahedral sites, such as $NiFe_2O_4$. For complex spinel, M (II) and Fe (III) occupy at the tetrahedral and octahedral sites randomly.[14]

2.2.2 Garnet Ferrites

Garnet ferrites are a type of composite material that combines the properties of both garnets and ferrites. The garnet crystal structure consists of metal ions, like iron, aluminium, and yttrium, along with oxygen ions. Unit cell is cubic. These metal ions are substituted into the crystal lattice of the garnet structure. Garnet ferrites have unique magnetic properties that make them useful in various applications. They exhibit high magnetic permeability, which means they can easily respond to and transmit magnetic fields. They also have low magnetic losses, meaning they retain their magnetism well. Additionally, garnet ferrites have high electrical resistivity, which allows them to resist the flow of electric current. It is magnetically hard.[15]

2.2.3 Ortho Ferrites

Ortho ferrites are a type of magnetic material that have a crystal structure called orthorhombic. An orthoferrite is chemical compounds with the formula $RFeO_3$, where R is one or more rare-earth elements and most are weakly ferromagnetic. They have high magnetic permeability, which means they can easily respond to and transmit magnetic fields. They also have low magnetic losses, so they can retain their magnetism really well and are stable even at different temperatures. In the absence of this interaction, the orthoferrites would be antiferromagnetic. Its presence leads to a small canting of the sub lattices, making the orthoferrites "weak" ferromagnets. Another interesting feature of these materials is the fact that some of them exhibit a transition as a function of temperature, in which the direction of the antiferromagnetically ordered spins and consequently also of the net magnetization rotates by 90°. One common use is in permanent magnets, in magnetic recording media, like tapes or hard drives, to store and retrieve data magnetically.

2.2.4 Hexaferrites

Hexagonal ferrites are also known as hexaferrites, are a type of ferrite material that have a hexagonal crystal structure. These ferrites are composed of iron oxide along with other elements such as barium, strontium, or lead, which are substituted into the crystal lattice. Hexagonal ferrites are known for their excellent high-frequency performance, low energy losses, and resistance to demagnetization. These properties make them valuable in telecommunications, radar systems, and other RF applications. They exhibit high magnetic anisotropy means their magnetic properties are directionally dependent. This makes them suitable for devices like antennas, circulators, isolators, and phase shifters. One common example of a hexagonal ferrite is barium hexaferrite, also known as $BaFe\_12\ O\_19$. It is composed of barium (Ba) ions and iron oxide ($Fe\_2\ O\_3$). Barium hexaferrite is often used in microwave devices and magnetic recording media due to its high coercivity and stability.[16]

CHAPTER 3

LITERATURE REVIEW

1. Preeti Thakur et al. (2021) [17], studied, Ni-Zn ferrites are one of the most versatile magnetic materials for both low and high frequency devices. In the last two decades, researchers have focused on enhancing the magnetic and electrical properties of these ferrites. These materials play a dominant role in many highend applications such as microwave devices, power transformers in electronics, rod antennas because of their excellent properties like high dc resistivity, low dielectric losses, high mechanical hardness, high Curie temperature, low production cost and good chemical stability. These properties are dependent on highly homogeneous and uniform crystallites of Ni-Zn ferrite nanoparticles prepared with different chemical methods. Moreover, optimization of different synthesis parameters like proper choice of dopants, different compositions, different sintering temperature and atmosphere are also equally important. All wet techniques like co-precipitation, citrate precursor, sol gel etc. have their own importance and are adopted based on the need of nanomaterials size and device fabrication. The low sintering temperature and slow heating rate will always result in uniform and homogenous crystallites. It has been observed that cobalt, copper and rare earth metals are widely doped in Ni-Zn ferrites and extensive investigations are performed by using XRD, SEM, TEM, FTIR, UV–Vis, VSM, LCR etc. Most of the investigations are aimed for tuning properties for high frequency applications.

2. G.S. Shahane et al. (2010) [18], published an article that, a low temperature chemical co-precipitation method can be used for synthesis of nanocrystalline nickel zinc ferrite particles with various compositions. The particle size can be effectively controlled by the pH of the reaction mixture, time and temperature of reaction. The X-ray diffraction patterns confirm the synthesis of single crystalline phase of $Ni_xZn_{1x}Fe_2O_4$ (x=0.1, 0.3, 0.5) nanoparticles. Lattice parameter decreases with the increase in nickel content, resulting in reduction in lattice strain. Similarly, crystallite size increases with increase in nickel content. The magnetic measurements show superparamagnetic nature of the samples for x=0.1 and 0.3 whereas for x=0.5 the material shows ferromagnetic nature with improvement in remanence and coercivity. The saturation magnetization is low and increases with increase in nickel content. The superparamagnetic nature of the samples with x=0.1 and 0.3 is supported by the EPR and ac susceptibility measurement studies. The properties of the Ni–Zn ferrites can be effectively tailored by changing the composition parameter.

3. Yuko Ichiyanagi et al. (2004) [19], $Ni_{(1-x)}Zn_{(x)}Fe_2O_4$ ($0 \leq x \leq 1$) mixed ferrite nanoparticles encapsulated with amorphous-SiO_2 were produced and magnetization measurements were performed. Particle sizes were controlled at about 6 nm through the calcination temperatures. Magnetization measurements of the FC and ZFC could be explained by the blocking of the superparamagnetic cluster model. The maximum value of Tb was observed at x=0.6, where anisotropy energy could be considered to be the largest. This might be an effect of the ion distribution in extremely small particles. Different blocking temperatures were found depending on the Zn concentration, and above Tb superparamagnetic behaviors were observed. Both of the highest permeability and the lowest coercivity was found at a Zn content of x=0.6. At that concentration magnetic parameters are optimum for soft magnetic materials. The value of the saturation magnetization M_s had the maximum when x=0.7, but M_s value of nanoparticles tended to be 30% lower than that of bulk crystal. This phenomenon could be due to the canting of surface spins of nanoparticles at a definite angle. The canting angle θ could be roughly estimated as θ=45°. These are characteristic behaviors of extremely small NiZn ferrite nanoparticle system.

4. Kamellia Nejati et al. (2012) [20] published that, nanosized nickel ferrite particles were synthesized with and without surfactant assisted hydrothermal methods. The results show that with increasing of temperature, the crystallinity of nanoparticles is increased. In the presence of surfactants, the crystallinity of $NiFe_2O_4$ nanoparticles decreased in comparison with surfactant- free prepared samples. All of the nickel ferrite nanoparticles were superparamagnetic at room temperature.

5. J. Azadmanjiri published a reasearch paper in (2008) [21], the sol–gel combustion method is convenient for synthesis of nano-sized Ni–Zn ferrites. A series of NiZn ferrite nanosized powders with composition $Ni_{1-x}Zn_xFe_2O_4$ (where x = 0, 0.1, 0.2, 0.3, 0.4) were synthesized by this novel method. In this method gel exhibits a self-propagating behavior after ignition in air. The synthesized powders exhibited high sintering activity, and can be sintered at temperature less than 950°C. The prepared low-temperature sintered Ni–Zn ferrites possess good electromagnetic properties, as well as fine-grained microstructures, making them good materials for electronic applications with high performance and low cost. Zn content has significant influence on the electromagnetic properties, such as dielectric constant, dielectric loss tangent and magnetic properties for Ni–Zn ferrites.

6. Carlos Andrés Palacio Gómeza et al. (2020) [22] studied, series of Nickel-Zinc ferrite samples ($Ni_{1-x}Zn_xFe_2O_4$, x = 0.0, 0.2, 0.4, 0.6, 0.8 and 1.0) were successfully prepared by using the low-energy ball milling method with a single subsequent thermal treatment of un-pressed samples. The samples were characterized by means of the infrared, Raman and Mössbauer

spectroscopic techniques. Our results are in agreement with those reported in the literature for samples prepared by other methods. The five Raman modes (A_{1g}+ E_g + $3F_{2g}$) were observed in all the Raman spectra, which also proves the purity of the samples. However, due to symmetry breaking, each of these modes were properly fitted by introducing two or three Lorentzian components. Infrared studies confirm the spinel structure of the ferrites as given by the tetrahedral absorption band frequencies located in the 548 cm^{-1} to 592 cm^{-1} range. With the increase in x, the variation of the v1 band position to a lower frequency side confirms the occupation of Zn ions at the tetrahedral sites. In $NiFe_2O_4$, each Fe_B^{3+} ion at the octahedral site is surrounded by Fe_A^{3+} ions at the tetrahedral sites. In $Ni_{1-x}Zn_xFe_2O_4$ as x increases, the number n of Zn_A^{2+} ons replacing Fe_A^{3+} ions at the tetrahedral sites increases. It was found that the average super transfered hyperfine field due to one Fe_A^{3+}–O^{2+}–Fe_B^{3+} super exchange interaction was equal to 0.9T at 18K. Therefore, as x increases the number of Zn_A^{2+}-O^{2+}-Fe_B^{3+} paths increases, then reducing the average hyperfine field. In general, the reduction of the average hyperfine magnetic field at the octahedral sites was well explained as due to a random substitution of magnetically interacting Fe_A^{3+} ions by diamagnetic Zn_A^{2+} ions at the tetrahedral sites. The tendency of large degree of obtaining mixed spinel structure is attenuated when using the low-energy method. Finally, the Zn content at tetrahedral sites were calculated from the intensities of the A_{1g} Raman bands, the relative areas of the A and B sites spectral components in the Mössbauer spectra and from the intensity ratio of certain Bragg peaks ($I_{(2\,2\,0)}/I_{(4\,4\,0)}$ and $I_{(4\,0\,0)}/I_{(2\,2\,0)}$) in the XRD patterns. The values were compared considering the different approximations required by each technique.

CHAPTER 4

METHODS AND PROCESS OF SYNTHESIS

4.1 METHODS

Various forms of nanostructures can be synthesized using the synthesis process shown in Fig. 5.1; a nanostructure can be defined as a structure with at least one or two dimensions in the 1–100 nm range. Nanoparticles can be synthesized using a variety of techniques. Dry particles and nanoparticles in liquid dispersion are synthesized by these techniques. Nanostructures can be generated by building from atoms or by diminishing the size from microparticle to nanoparticle.

PHYSICAL METHOD	CHEMICAL METHOD	BIOLOGICAL METHOD
MECHANICAL METHODS	CO-PRECIPITATION METHOD	SYNTHESIS USING PLANT EXTRACTS
VAPOUR DEPOSITION	SOL-GEL METHOD	SYNTHESIS USING ENZYMES
SPUTTER DEPOSITION	MICROEMULSIONS	SYNTHESIS USING AGRICULTURAL WASTE
ELECTRIC ARC DEPOSITION	HYDROTHERMAL SYNTHESIS	
ION BEAM TECHNIQUE	SONOCHEMICAL SYNTHESIS	
MOLECULAR BEAM EPITAXY	MICROWAVE SYNTHESIS	

- Hydrothermal method -

Hydrothermal synthesis refers to the synthesis by chemical reactions of substances in a sealed heated solution above the ambient temperature and pressure. Hydrothermal synthesis of single crystals depends on the solubility of minerals in hot water under high pressure. The crystal growth is performed in an apparatus consisting of a steel pressure vessel called an autoclave, in which a nutrient is supplied along with water. A gradient of temperature is maintained at the opposite ends of the growth chamber so that the hotter end dissolves the nutrient and the cooler end causes seeds to take additional growth.

- Sol- gel -

Sol-gel is a method for producing solid materials from small molecules. In this chemical procedure, the sol gradually evolves toward the formation of a gel-like diphasic system containing both a liquid phase and a solid phase, the morphologies of which range from discrete particles to continuous polymer networks. Ultrafine and uniform ceramic powders can be formed by precipitation. These powders of single and multicomponent composition can be produced on a nanoscale particle size for dental and biomedical applications.[23]

- Co-precipitation -

Constant-pH co-precipitation is a standard synthesis technique for catalyst precursors and referred to as the method of low supersaturation. By proper adjustment of the precipitation parameters the homogeneous distribution of different metal cations in a mixed solution can be carried over to a multinary catalyst precursor by rapid solidification. Contrarily to the also commonly used impregnation methods for pre-formed supports, these materials contain the precursor species for the support and for the active components in the same material. Highly dispersed, well inter-mixed and uniform supported metal/oxide catalysts can be obtained from such precursors by decomposition (typically calcination) and/or reduction. For applied systems, the empirical synthesis optimization is often far more advanced than the exact knowledge of the underlying chemistry. Thus, the evolution of many applied catalyst syntheses is usually a continuous long-term process that to a large extent is based on the experience of the manufacturer and their accumulated knowledge often leads to complex recipes. This complexity is sometimes generalized as the "black magic" of catalyst synthesis.[24]

- Microemulsions -

This method is one of the ideal techniques for the preparation of inorganic nanoparticles, yet the mechanism of nanoparticle formation in the microemulsion has not yet been understood well. Some researchers have suggested a mechanism for nanoparticle synthesis within microemulsions. When the microemulsion material, including reactants, are mixed together, reactant exchange takes place during the collision of water droplets in the microemulsion. The reactant exchange is too fast and a precipitation reaction occurs in the nanodroplets, which is followed by nucleation growth and coagulation of primary particles, resulting in the final nanoparticles surrounded by water and/or stabilized by surfactants.

- Laser ablation -

Laser ablation is the process of removing material from a solid surface by irradiating it with a laser beam. At low laser flux, the material is heated by the absorbed laser energy and evaporates or sublimates. At high laser flux, the material is typically converted to plasma. Usually, laser ablation refers to removing material with a pulsed laser, but it is possible to ablate material with a continuous wave laser beam if the laser intensity is high enough.

- High -energy ball milling -

A process in which a powder mixture placed in a ball mill is subjected to high-energy collisions from the balls. High-energy ball milling, also called mechanical alloying, can successfully produce fine, uniform dispersions of oxide particles in nickel-base super alloys

that cannot be made by conventional powder metallurgy methods. This process is a way of modifying the conditions in which chemical reactions usually take place, either by changing the reactivity of as-milled solids or by inducing chemical reactions during milling.

- Biological synthesis -

Biological synthesis of nanoparticles is a green chemistry approach that interconnects nanotechnology and biotechnology. However, despite the stability, biological nanoparticles are not monodispersed and the rate of synthesis is slow. The concentration of synthesized macromolecules involved in the nucleation of particles varies with time and prolongs the nucleation period, which causes polydispersity of nanoparticles and subsequent decreased rate of synthesis. In order to overcome these problems, several methods, such as microbial cultivation methods and the extraction techniques, have to be optimized, such as photobiological methods, may be used. Owing to the rich biodiversity of plants and microbes, the potential as biological materials for nanoparticle synthesis is yet to be fully explored.[25]

4.2 PROCESS OF SYNTHESIS

Given Series - **$Ni_{0.5}$ $Zn_{0.5}$ Fe_2O_4**

Methods that are used to synthesis ferrites nanoparticles are

4.2.1 CO-PRECIPITATION METHOD -

Sr. No.	Chemical used	Molecular Weight	For 50 ml of solution
01.	Zinc chloride	136.30 g/mol	0.6815 gm
02.	Nickel Chloride	237.69 g/mol	1.18845 gm
03.	Ferric Chloride	162.21 g/mol	3.2442 gm
04.	Sodium Hydroxide	40.00 g/mol	8.00 gm

Synthesis process involve following steps

STEP 1- At first, 3 beakers are cleaned properly and 50 ml of distilled water is added in each beaker. Now chemicals are weighted with the help of weighing machine as shown in the calculations. After that, Zinc Chloride and Nickel Chloride is added in first beaker, Ferric Chloride is added in second beaker and NaOH is added in the third beaker. After, all these chemicals are added in distilled water, first two beakers and magnetic needle in it, it is kept for

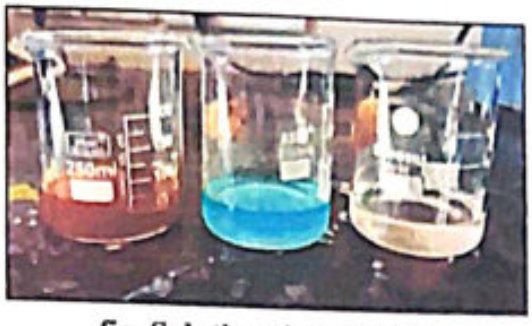


fig. Solutions in beakers

stirring on magnetic stirrer for 20 minutes. Now solution from second beaker is transferred to first beaker and kept for heating and stirring for another 20 minutes.

fig. Titration

STEP 2- When the temperature of solution is reached to 80° Celsius, titration using NaOH solution in burette is started. By titration, we are adding base to acid dropwise, while maintaining the pH of 12 for the synthesis. After attending the pH value of 12, the solution is kept for heating and stirring till its water is evaporated to get precipitation i.e. for almost 2 hours.

fig. Filtration

fig. Crushing

fig. Calcination

4.2.2 SOL-GEL AUTO COMBUSTION METHOD -

Sr. No.	Chemical used	Molecular weight	For 30 ml solution
01.	Zinc Nitrate	237.70 g/mol	2.42180402 gm
02.	Nickel Nitrate	290.80 g/mol	2.9628128 gm
03.	Ferric Nitrate	404.00 g/mol	16.46459948 gm
04.	Urea	60.06 g/mol	8.1507836 gm

Synthesis involves following steps

STEP 1- At first 30 ml of distilled water is taken in a beaker and Zinc nitrate, Nickel nitrate, Ferric nitrate and Urea are added to it to form homogenous solution. This process is known as hydrolysis.

Fig. Hydrolysis

STEP 2- Then the beaker is placed on a magnetic stirrer with a needle in it and stirred for 20 minutes. After stirring, it is kept for heating about 2 hours.

STEP 3- Heating and stirring is continued till gel is formed in the beaker. This method is known as gelation.

STEP 4- Once, the gel formation takes place in a beaker, it is shifted to heater where it is heated till fire or till auto-combustion occur. Auto combustion occur due to presence of urea. Now gel is completely transferred in solid mass.

STEP 5- And the material is ready for grinding for almost 3 hours and then it is placed in the furnace at 800degree Celsius for calcination.

STEP 6- Now the sample is ready for the characterization such as XRD, FTIR and Raman Spectroscopy.

fig. Gel formation

fig. Auto-Combustion

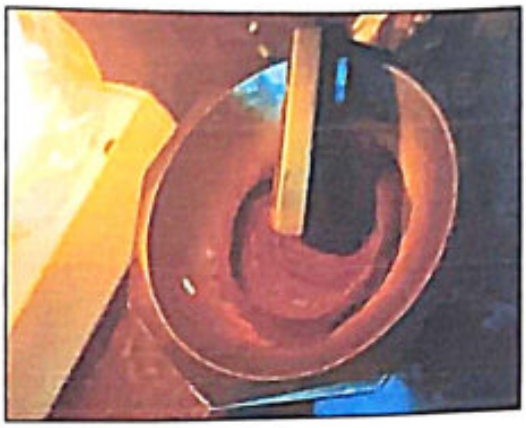


fig. Crushing

4.2.3 HYDROTHERMAL METHOD -

Sr. No.	Chemical used	Molecular weight	For 50 ml of solution
01.	Zinc Chloride	136.30 g/mol	0.6815 gm
02.	Nickel Chloride	237.69 g/mol	1.18845 gm
03.	Ferric Chloride	162.21 g/mol	3.2442 gm
04.	Sodium Hydroxide	40.00 g/mol	8.00 gm

Synthesis involves following steps

STEP 1- At first, 3 beakers are cleaned properly and 50 ml of distilled water is added in each beaker. Now chemicals are weighted with the help of weighing machine as shown in the calculations. After that, Zinc Chloride and Nickel Chloride is added in first beaker, Ferric Chloride is added in second beaker and NaOH is added in the third beaker. After, all these chemicals are added in distilled water, first two beakers and a magnetic needle in it, it is kept for stirring on magnetic stirrer for 20 minutes. Now solution from second beaker is transferred to first beaker and kept for heating and stirring for another 20 minutes.

STEP 2- When the temperature of solution is reached to 80 °Celsius, titration using NaOH solution in burette is started. By titration, we are adding base to acid dropwise, while maintaining the pH of 12 for the synthesis. After attending the pH value of 12, the solution is kept for heating and stirring till its water is evaporated to get precipitation i.e. for almost 2 hours.

STEP 3- Now the solution is transferred to the autoclave and is kept in the oven for next 20 hours.

STEP 4- Next day, the solution is filtered with the help of Whatman filter paper three times using distilled water and then with acetone. Once this process is completed, it is kept for drying in hot air oven at 800° C temperature for 5 hours.

STEP 5- Now the material is taken out and grinded it in the mortar pestle for near about 3 hours.

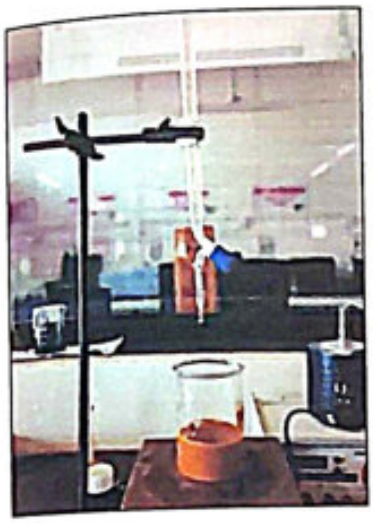


fig. Titration

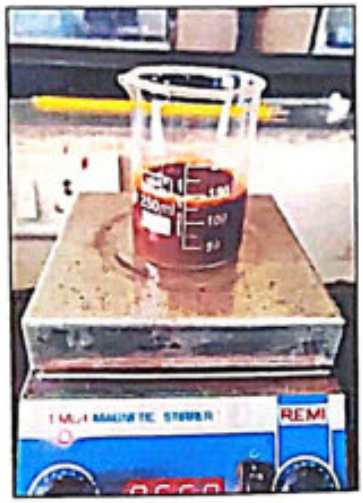


fig. Solution for heating

fig. Autoclave kept in oven

fig. Filtration

fig. Crushing

STEP 6 – Finally, the material is ready for further characterization such as XRD, FTIR and Raman Spectroscopy.

CHAPTER 5

CHARACTERIZATION TECHNIQUES

5.1 X-RAY DIFFRACTION

X-ray diffraction (XRD) is a powerful nondestructive technique for characterizing crystalline materials. It provides information on structures, phases, preferred crystal orientations (texture), and other structural parameters, such as average grain size, crystallinity, strain, and crystal defects. X-ray diffraction peaks are produced by constructive interference of a monochromatic beam of X-rays scattered at specific angles from each set of lattice planes in a sample. The peak intensities are determined by the distribution of atoms within the lattice. Consequently, the X-ray diffraction pattern is the fingerprint of periodic atomic arrangements in a given material.[26]

Principle and working of XRD

Crystals are regular arrays of atoms, whilst X-rays can be considered as waves of electromagnetic radiation. Crystal atoms scatter incident X-rays, primarily through interaction with the atoms' electrons. This phenomenon is known as elastic scattering; the electron is known as the scatterer. A regular array of scatterers produces a regular array of spherical waves. In the majority of directions, these waves cancel each other out through destructive interference, however, they add constructively in a few specific directions, as determined by Bragg's law:

$2d\sin\theta = n\lambda$

Where d is the spacing between diffracting planes, θ is the incident angle, n is an integer, and λ is the beam wavelength. The specific directions appear as spots on the diffraction pattern called reflections. Consequently, X-ray diffraction patterns result from electromagnetic waves impinging on a regular array of scatterers. X-rays are used to produce the diffraction pattern because their wavelength, λ, is often the same order of magnitude as the spacing, d, between the crystal planes (1-100 angstroms).[27]

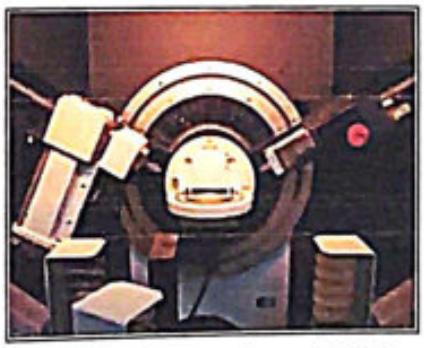


fig. Instrumentation of XRD

Applications of XRD

XRD is a non-destructive technique used to

- Identify crystalline phases and orientation
- Determine structural properties:

- Lattice parameters
- Strain
- Grain size
- Epitaxy
- Phase composition
- Preferred orientation

- Measure thickness of thin films and multi-layers
- Determine atomic arrangement

5.2 FTIR [Fourier Transform Infrared Spectroscopy]

FTIR stands for Fourier transform infrared, the preferred method of infrared (IR) spectroscopy. FTIR Spectroscopy is an analytical technique used to identify organic, polymeric, and, in some cases, inorganic materials. The FTIR analysis method uses infrared light to scan test samples and observe chemical properties.

Principle and working of FTIR-

The instrument that determines the absorption spectrum for a compound is called a spectrophotometer. Fourier transform spectrophotometer provides the IR spectrum much more rapidly compared to the traditional spectrophotometer. The instrument produces a beam of IR irradiation, which is emitted from a glowing black-body source. Subsequently, the beam passes through into interferometer where the spectral encoding takes place. The recombination of beams with different in path lengths in the interferometer creates constructive and destructive interference called an interferogram. The beam now enters the samples compartment and the sample absorbs specific frequencies of energy, which are uniquely characteristic of the sample from the interferogram. Then, the detector measures the special interferogram signal in energy versus time for all frequencies simultaneously. In the meantime, a beam is superimposed to provide a reference (background) for the instrument operation. Finally, the desirable spectrum was obtained after the interferogram automatically subtracted the spectrum of the background from the sample spectrum by Fourier transformation computer software.[28]

FTIR analysis is used to

- Identify and characterize unknown materials (e.g., films, solids, powders, or liquids)
- Identify contamination on or in a material (e.g., particles, fibers, powders, or liquids)
- Identify additives after extraction from a polymer matrix.
- Identify oxidation, decomposition, or uncured monomers in failure analysis investigations.[29]

fig. Instrumentation of FTIR

CHAPTER 6

RESULT AND DISCUSSION

6.1 XRD RESULTS

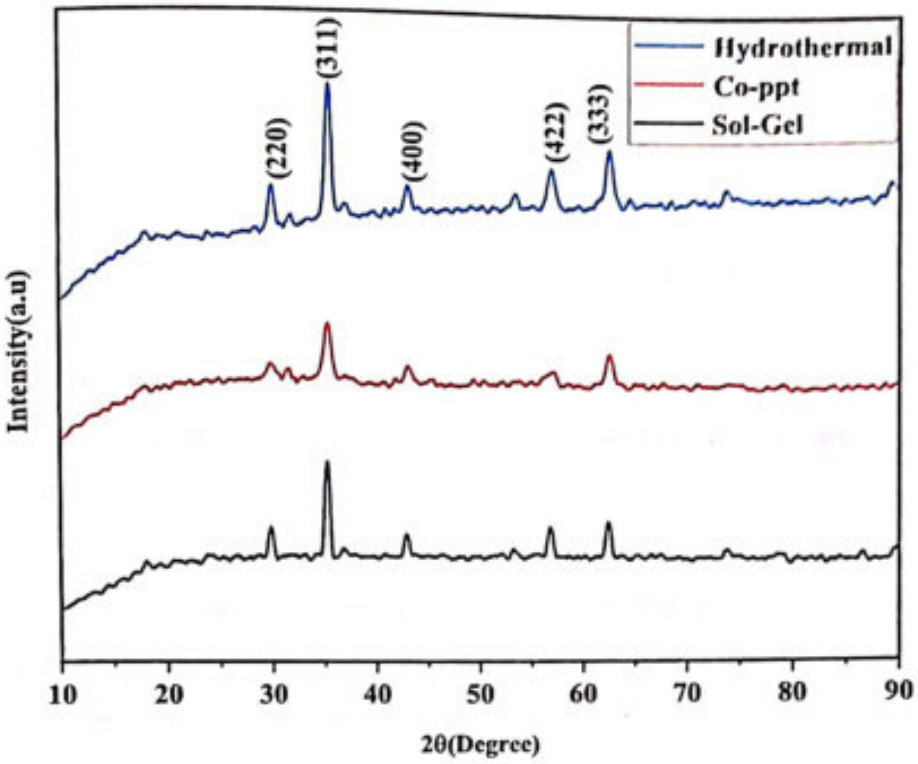


Fig. 6.1.1 XRD RESULT GRAPH

Table 6.1:- Peak position, lattice dimensions, crystalline size, strain, dislocation density, interplanar spacing and X-ray density fraction of $Ni_{0.5}Zn_{0.5}Fe_2O_4$.

Sr. No.	Method	2θ (degree)	a(A°)	D× 10^{-9} (m)	ε × 10^{-3}	δ × 10^{15} lines/m^2	β (deg)	d-spacing (A°)	$\rho_{x\text{-}ray}$ (g/cm^3)
1.	Sol-gel	35.134	8.4643	25.652	4.47703	1.51969	0.325	2.5521	5.20752
2.	Co-ppt	35.11	8.4699	12.825	8.96058	6.07974	0.65	2.5538	5.19713
3.	Hydrothermal	35.28	8.4305	16.039	7.131662	3.88712	0.52	2.5419	5.27046

- X-ray diffraction of the prepared Nano crystalline sample $Ni_{0.5}Zn_{0.5}Fe_2O_4$ by Sol-Gel Auto-combustion, Co-precipitation and Hydrothermal method has been studied for the determination of crystallographic structure.
- The intensity of (311) plane is more as compared to other planes like (220), (440), (422) and (333) and is chosen for the determination of crystallite size as per the standard reference data of Joint Committee on Powder Diffraction Standard (JCPDS file No 74-2403) which confirms the formation of spinel ferrite with space group Fd-3m.

- The average crystallite size of synthesized compounds was calculated by the full width at half maximum, (FWHM) of diffraction based on the Debye Scherrer's formula

$$D=K\lambda/\beta COS\theta$$

- The crystallite size of the compounds by Sol-gel auto-combustion, Co-precipitation and hydrothermal methods is found to be 25.652 nm, 12.825 nm, 16.039 nm respectively. The difference observed in the crystallite size is due to presence of impurity phases in samples.
- The lattice dimension for all (hkl) planes have been calculated by using the formula,

$$A=d_{hkl}\,(h_2+k_2+l_2)^{1/2}$$

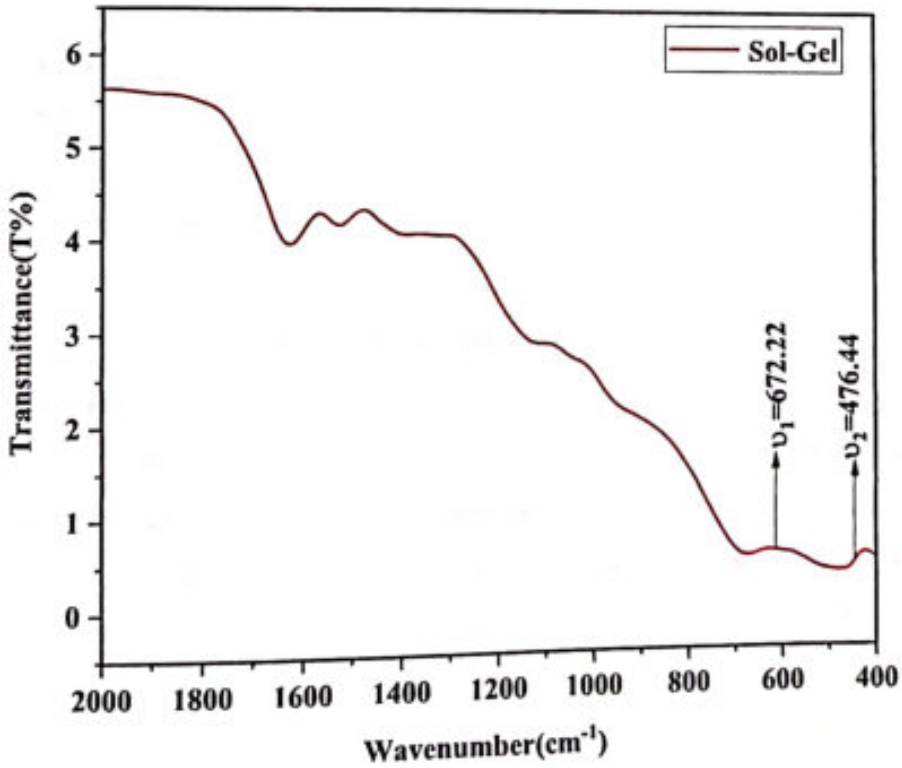
- The value of lattice dimension of the given sample for Sol gel, Co-ppt and Hydrothermal are 8.4643 A°, 8.4699 A° and 8.4305 A° found good agreement with earlier reports.
- The X- ray density calculated from following relation

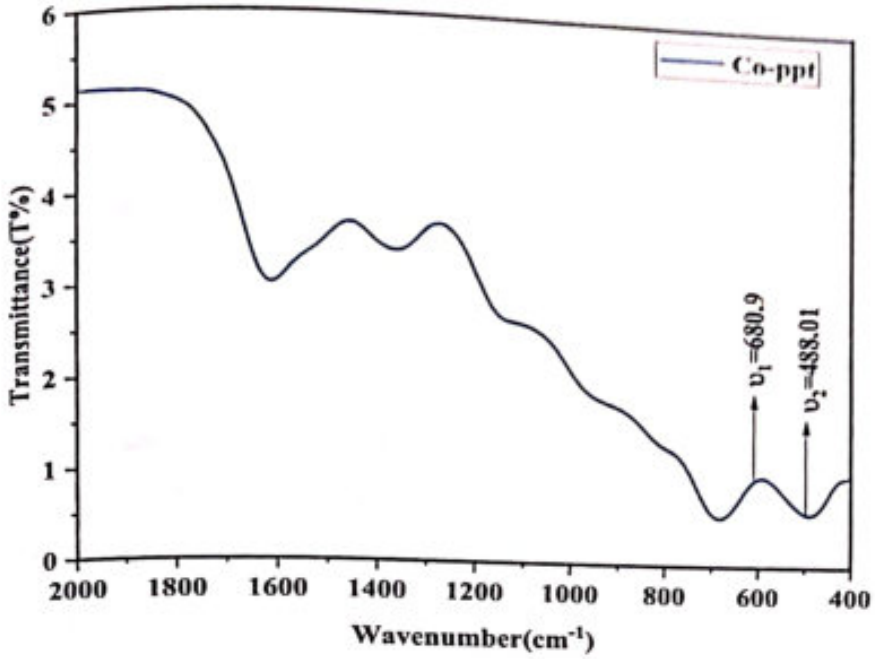
$$dx= ZM/N_AV$$

Where Z=8, M=237.64 gm/mol and V= volume of unit cell=a^3

- It is observed that, X-ray density for Sol gel is 5.20752 gm/cm^3, Co-ppt is 5.19713 gm/cm^3 and Hydrothermal is 5.27046 gm/cm^3.

6.2 FTIR RESULTS





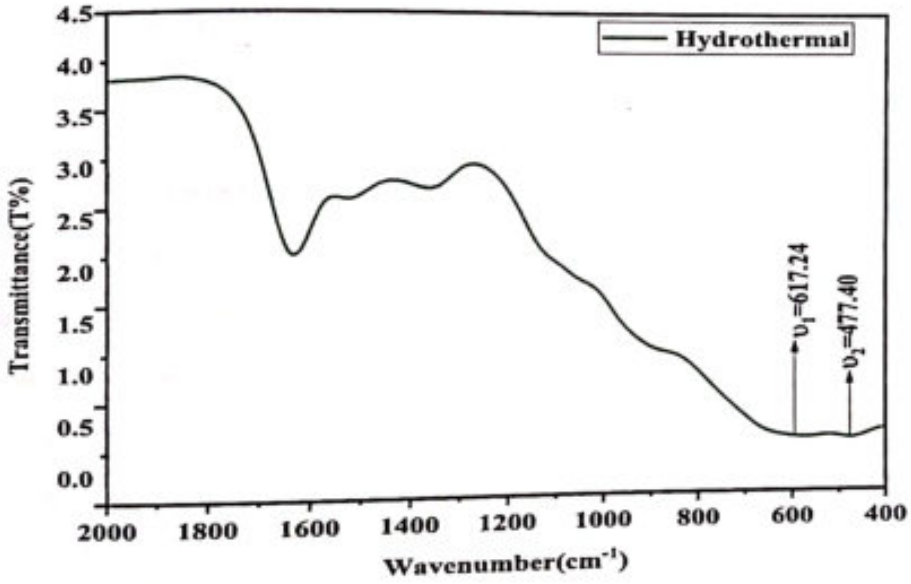


Fig 6.2.1 FTIR RESULT GRAPH

Table 6.2: - Wavenumber, force constant and Debye temperature of $Ni_{0.5}Zn_{0.5}Fe_2O_4$.

Sr. No.	Sample	Wave Number (A-Site)	Wave Number (B-site)	Force Constant (A – Site) $K_t \times 10^2$	Force Constant (B-site) $K_o \times 10^2$	Average Force Constant $K_{av}=(K_t+K_o)/2\times 10^2$	Debye Temperature $(\theta\_D)\times 10^2$
1	Sol-gel	672.22	476.44	3.3164	1.6635	2.48999	1.3173
2	Co-ppt	680.90	488.01	3.3977	1.7453	2.57150	1.3405
3	Hydrothermal	617.24	477.40	2.7920	1.6702	2.2311	1.2553

CHAPTER 7

CONCLUSION

- In this project, $Ni_{0.5}Zn_{0.5}Fe_2O_4$ is successfully synthesized with the aim of studying impact of different synthesis approaches like Sol-gel Auto-Combustion, Co-precipitation and Hydrothermal on structural and spectroscopic parameters.
- Characterization of prepared samples are done by using XRD, FTIR and Raman Spectroscopy techniques.
- The structural property has been studied using X-ray diffraction technique which confirm the formation of spinel ferrite with space group Fd-3m.
- The various structural parameters such as crystallite size, lattice dimension, X-ray density, strain, dislocation density and volume were calculated and found good agreement with previous reports.
- The crystallite size for most intense (311) peak were calculated using Scherrer's equation and comparative study shows that sample made by Co-ppt which was analyzed by XRD was found to have less dimensions for crystallite size and therefore has less x-ray density as compared to Sol-gel Auto-Combustion and Hydrothermal methods.
- The vibrational spectroscopic / optical properties were studied using FTIR. The presence of two strong absorption band around 650 cm^{-1} and 450 cm^{-1} confirms the formation metal-oxygen bond of mixed spinel ferrite. The strength of the bond was calculated using force constant.
- And from FTIR, the proper vibrational bands were observed for hydrothermal as compared to Sol-gel Auto-Combustion and Co-precipitation methods.
- Molecular vibrations, crystal structures and chemical bonding in the sample $Ni_{0.5}Zn_{0.5}Fe_2O_4$ for Sol-Gel Auto-Combustion, Co-precipitation And Hydrothermal are characterized by using Raman spectroscopy.
- Raman spectroscopy is performed at 520 nm range for different time in seconds. Samples are characterized at the range of 0-1000 wavelength.

CHAPTER 8

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ROLE OF PLANT BASED ENZYME- A SUSTAINABLE APPROACH

Project work
Submitted for

Partial fulfillment of the degree of

MASTER OF SCIENCE
(M.Sc.-II, Semester-IV)

IN
MICROBIOLOGY

Submitted by
Ms. NIMMI DILIP KUMBHARE

Shri Shivaji Education Society Amravati's
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2023-2024

TABLE OF CONTENTS

DECLARATION

I, the undersigned hereby declare that the research work presented in this project entitled, **"Role of plant based enzyme- a sustainable approach"** has been carried out under the guidance and supervision of **Dr. Pranita B. Gulhane,** Assistant Professor & Supervisor, Department of Microbiology, S.S.E.S.A's Science College, Congress Nagar, Nagpur.

This work or any part of this work is based on original research and has not been submitted to any University/Institution for the award of any degree or diploma.

Place- Nagpur

Date- 18/05/2024

Nimmi

Ms. Nimmi D. Kumbhare

CERTIFICATE

This is to certify that the research work presented in this thesis entitled, **"Role of plant based enzyme- a sustainable approach"** is the own work of **Ms. Nimmi D. Kumbhare** conducted in P. G. Department of Microbiology, S.S.E.S.A's Science College, Congress Nagar, Nagpur under my supervision.

This work has not been submitted earlier to any other University/Institution for the award of any degree or diploma.

Place- Nagpur
Date- 18/07/2024

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NAGPUR.

SEAL

Evaluated

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I wish to express my sincere thanks to all those who helped me directly or indirectly throughout the project. Thank you. I would like to praise and thank God, the almighty, who has granted countless blessing, knowledge and opportunity to the writer, so that I have been finally able to accomplish the thesis.

- Ms. Nimmi D Kumbhare

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ABBREVIATIONS

Abbrevations	Meaning	Page No.
T	Time taken for formation of clots (s).	22
V_S	Volume of milk (ml).	22
V_E	Volume of enzyme (ml).	22
TOC	Time of clotting.	33
MCA	Milk clotting activity.	33
ND	Not detected.	33
I	Indole test.	38
M	Methyl-red test.	38
V	Voges-proskauer test.	38
C	Citrate-utilisation test.	38
S	Slant.	38
B	Butt.	38
G	Glucose.	38
S	Sucrose.	38
L	Lactose.	38
M	Mannitol.	38
U	Urease test.	38
Ca	Catalase test.	38
A	Acid production.	38
AG	Acid and gas production.	38
R	Resistant.	40
S	Sensitive.	40

CHAPTER I
INTRODUCTION

1. INTRODUCTION

1. CHEESE:

Cheese is the fresh or ripened solid or semi-solid product in which obtained by coagulating milk through the action of rennet or other suitable coagulating agents, acidification, or a combination of rennet and acidification methods (Shah et al., 2013). Nutritious rich food, cheese is made mostly from the milk of cows, buffaloes, sheeps or goats, and it is an important food component in the healthy diet of American, Asian and European (Ash et al., 2010).

Cheese provides a rich source of proteins, peptides, amino acids, short-medium and long- chain fatty acids, vitamins, and essential minerals including calcium. A large variety of cheeses has been produced in the world to meet the requirements of taste and health need of individuals. But their consumption varies with individual, race, ethnicity of people and type of milk in cheese preparation. In recent years, cheese found to be health beneficial due to the presence of health promoting factors, such as essential amino acids, free fatty acids and so on. Numerous factors which include type of milk, lactation period, ripening process, type of starter used can vary the nutritional components of the cheese. The fully ripened cheese contains highly water soluble components than its source, milk (Kosikooski et al., 1997).

It also contains several peptides which has various bioactive roles in humans. These peptides can be generated not only during the ripening process of cheese but also can generate during the digestion process in human tract. Bioactive peptides generated during the ripening as well as during digestion are found to be health beneficial, such as ACE-inhibitory activity (Macchi and Gobbetti 1998).

The peptides derived from the casein and whey proteins are also serving as prominent source for the nutraceutical functional foods. Cheese also generates certain free amino acids by the actions of enzymes produced by the starter culture and rennet. However, the amount of free amino acids present in cheese varies with the source of milk and rennet used. Biogenic amine formed during decarboxylation of free amino acids by the action of microorganisms which are added during the preparation process or by contaminant also lowers the amino acid index in cheese. The enhanced

digestibility of cheese can be produced by the breakdown of casein during ripening of cheese. The potential and the nutrient significant of cheese are of wide range due to the presence of potentially significant amount of both saturated and unsaturated fat. However, different type of fats has different health effects and not all saturated fats elevated the plasma cholesterol (Kwak et al., 2012).

Cheese also acts as good source minerals, vitamins, and probiotic bacteria which have various health enhancing effects. Cheese contains concentrated source of calcium and it helps in the prevention of osteoporosis of future. Among the various vitamins in cheese, water soluble vitamins are extensively lost during the cheese preparation. But some water soluble vitamins are retained, such as niacin, folate and vitamin B12. Folic acid is important for the reduction of homocysteine in blood. Fat soluble vitamins, such as vitamin A, are essential in immune system which also found high in cheese. It enhances the flavor of cheese during ripening by the action of its enzymes. It also produces certain peptides and amino acids which increase the bioactivities of cheese on human health (Kwak et al., 2012).

2. MILK COAGULATION:

Milk coagulation is the main step for producing cheese, and coagulating enzymes, which are preparations of proteolytic enzymes, have been used in cheese making for thousands of years, and they seem to be the oldest known application of enzymes. Historically, most enzyme preparations used for cheese have been extracts from the stomachs of ruminants, but coagulants from microbes and plants were also used at very early dates (Jacob 2011).

The coagulation of milk is the basic step in the manufacture of all types of cheeses. The addition of rennet or coagulating agents has been greatly used in the coagulation of milk for the production of cheese. Calves'rennet contains a very high concentration of chymosin which is also known as rennin, which could account for up to 95% of the total proteases found in young calves' abomasum extract. Due to its ability to separate milk into curds and whey, rennet is important for cheese production. As the demand for cheese products has increased by a factor of approximately about 3.5 since 1961,

the enzyme used as rennet enzyme supplied for cheese production is reduced due to the limited availability of ruminant stomach (Shah et al., 2013).

The worldwide increase in cheese production has reduced the availability of rennin, which became short in supply and expensive for local farmers. The reduced supply of rennin has led to the search for coagulant substitutes. Numbers of proteolytic enzymes from various sources have been used: bovine, porcine and chicken pepsins, fish chymotrypsins as well as proteases of fungi and transgenic microorganisms (Lopez et al., 1998). The use of these coagulants gave rise to unwanted final products, and led to ethic (been against genetically engineered foods), religious (Judaism and Islam), diet (vegetarianism) and public health problems (bird flu, bovine spongiform encephalopathy, H1N1 virus and microbial toxins) (Roseiro et al., 2003).

Recent publications on new proteases from vegetable origin for milk coagulation indicated that they are subject with growing interest for dairy technology. Plant coagulants have been used in cheese-making since fifty centuries before our era. Since the renewal of interest in 1960, vegetable coagulants have been used the more in dairy technology; especially at the artisanal scale (Silva and Malcata 2005). Cheese production with plant coagulants contributes significantly to the socioeconomic development of a locality, region and hence whole country where it is produced. Protein input is improved for those populations to whom restrictions are imposed by the use of animal and microbial coagulants. The technology led by farmers is easy and straightforward (Roseiro et al., 2003).

Most of the coagulants from microbial sources that have been investigated appear to be extracellular in nature and thus these microbes are likely candidates for the elaboration of milk coagulants. Consumer acceptance of cheeses made with microbial rennets does not pose any problems as such products have been classified as "vegetarian" cheeses. Seeking an alternative new rennet substitute becomes demanding in order to increase global demand for diversified and high-quality cheese production. Plant rennets have become a subject of growing interest in the cheese industry, due to their easy availability and simple purification processes (Grozdanovic et al., 2013).

3. PROTEASES:

A **protease** (also called a **peptidase, proteinase,** or **proteolytic enzyme**) is an enzyme that catalyze proteolysis, breaking down proteins into smaller polypeptides or single amino acids, and spurring the formation of new protein products (Lopez and Bond 2008).

Enzymes are the complex protein molecules, often called biocatalysts, which are produced by living cells. They are highly specific both in the reactions that they catalyze and in their choice of reactants, which are known as substrates. An enzyme typically catalyzes a single chemical reaction or a set of closely related reactions. Enzymes can also be defined as soluble, colloidal and organic catalysts that are produced by living cells, but are capable of acting independently of the cells (Berg et al., 2002).

❖ History:

Pepsin, an aspartic protease of the stomach, was one of the first enzymes to be discovered, characterized, and named (in 1825), and it was crystallized in 1930 (Northrup 1930). Studies of pepsin's action can be found in the JBC as far back as in 1907, and mechanistic studies were well on the way in the 1970s.

❖ Plant proteases:

Proteases are enzymes that hydrolyze protein molecules into peptides and amino acids. Proteases are required by plants in all aspects of their life cycle. The research has been directed towards discovering milk-clotting enzymes which would satisfactory replace calf rennet in cheese making, including microbial, recombinant, and plant-based enzymes (Jacob et al., 2011). The most important substitutes which fulfill the requirements of cheese manufacture include microbial, recombinant, and plant-based enzymes which have been isolated and studied. Rennet substitutes produced by microorganisms and genetically engineered microorganisms have proven to be suitable substitutes for animal rennet, but increasing interest has been directed toward vegetable coagulants i.e., the milk-clotting enzymes extracted from plants.

CHAPTER II
AIM AND OBJECTIVES

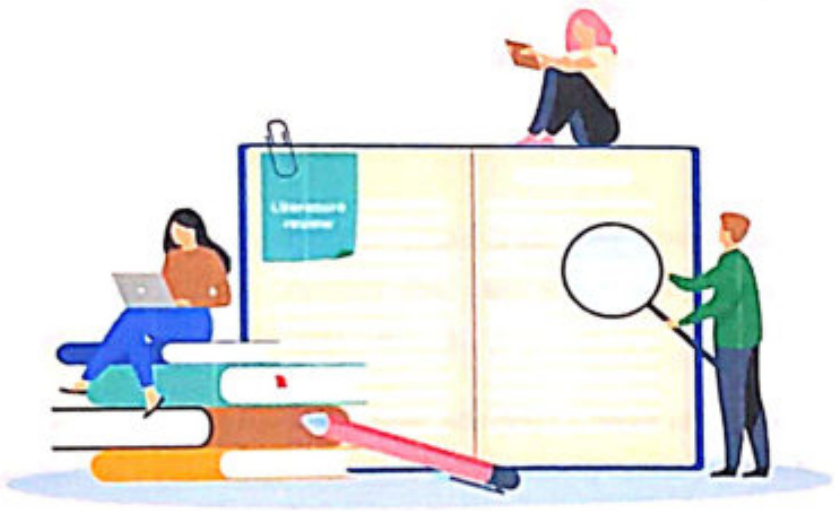
2. AIM AND OBJECTIVES

❖ **Aim :-** The aim of the present study was to investigate the role of plant based enzyme: a sustainable development by producing a cheese with the goodness of papaya and drumstick powder & isolation of probiotic bacteria.

❖ **Objectives:-** The objectives of the present work were:

1. To extract the milk clotting enzymes from *Carica papaya* and *Moringa oleifera.*
2. To examine the characterization of extracted purified enzyme.
3. To produce a cheese from extracted enzyme.
4. To isolate and identify the probiotic bacteria.
5. To study the Antibiotic resistance profile against bacterial isolates.

CHAPTER III
REVIEW OF LITERATURE



3. REVIEW OF LITERATURE

Kunitz (1947) examined that the protease activity can be assayed by using casein as a substrate.

J. R. E. Wells (1965) reported that a proteolytic enzyme with some features of a carboxypeptidase has been purified some 1180-fold from the sap of French beans (Phaseolus vulgaris var. Prince). A bright blue protein, plastocyanin, was separated from the enzyme by DEAE-cellulose chromatography.

Arima et al., (1967) stated that out of some 800 strains of microorganisms, a potent fungus for milk clotting enzyme was isolated from soil during the course of screening tests and was identified as one of strains of *Mucor pusillus* Lindt. Satisfactory results were obtained in cheese making experiments with this enzyme.

Derso and Dagnew (1970) evaluated the milk-clotting activity was screened from leaves of *Carica papaya, Mangifera indica* and *Moringa oleifera* in order to use the leaf with the highest milk-clotting activity as a source of the enzyme. The results of the present study showed that milk-clotting activity was only detected in the leaf extracts of *Carica papaya* and *Moringa oleifera* and the leaf extract from the leaf of *Mangifera indica* showed no activity.

Kawai and Mukai (1970) stated the course of screening tests of Basidiomycetes proteolytic enzymes, it was observed that some strains produced milk clotting enzymes with fairly weak proteolytic activities.

Nelson (1975) studied that Veal rennet now plays a minor role in United States cheese production, reflecting an inadequate and continually decreasing supply.

Pearson and Hapchuk (1978) evaluated the two strains of *Clostridium perfringens* (ATCC 12915 and 13124) exhibited excellent growth on amino acid and peptone media, only one (ATCC 13124) produced measurable proteolytic enzyme activity. Thus, subsequent purification steps concentrated on isolation of a proteolytic enzyme preparation produced by this strain.

Giori et al., (1985) reported that the effect of temperature and pH on the proteolytic activity of lactic acid bacteria was studied. *Lactobacilli* and thermophilic streptococci showed highest proteolysis at 15 and 45°C, and mesophilic *streptococci* exhibited only slight activity at all temperatures used. Variations in pH also had a strong influence on casein hydrolysis; this effect was more evident in *streptococci* than in *lactobacilli*.

Musilek et al., (1989) reported that Basidiomycetes *Phellinus chrysoloma*, *Kuehneromyces mutabilis* and *Ganoderma applanatum* produce extracellular milk-clotting enzymes.

Winwood (1989) stated that the use of calf rennet substitutes in cheese manufacture will increase because of costs linked with the availability of calf vells on the world market and the development of new cheese making processes such as ultrafiltration. The development of recombinant DNA techniques for chymosin production will also have an impact on the traditional calf rennet market when rennet manufacture by this method has been perfect.

Cserhati and Szogyi (1990) given that the effect of 33 polyethoxylated nonionic tensides with various hydrophobic moieties was studied on the proteolytic activity and phase transition behaviour of papain. Tensides with longer ethyleneoxide chain markedly increased the phase transition temperatures of papain indicating possible hydrogen bond formation between the hydrophilic ethyleneoxide chain and the polar sub-structures of papain.

Uhlig (1998) studied the cysteine proteases derived from plant sources, such as papain and bromelain from papaya and pineapple, respectively, have been used as meat tenderizers as well in baking and production of protein hydrolysates.

Cupp-Enyard (2008) given the Sigma's non-specific protease activity assay may be used as a standardized procedure to determine the activity of proteases, which is what we do during our quality control procedures. In this assay, casein acts as a substrate.

Brzostek and Finzi (2011) demonstrated the study were to determine whether and how temperature and substrate availability affect the activity of proteolytic enzymes in temperate forest soils, and whether the activity of proteolytic enzymes and other enzymes involved in the acquisition of N (i.e., chitinolytic and ligninolytic enzymes) differs between trees species that form associations with either ectomycorrhizal or arbuscular mycorrhizal fungi.

Anusha R et al., (2013) shows that the screening of Latex of latex producing plants from Euphorbiaceae, Asclepiadaccae, and Apocyanaceae families for their milk clotting efficiency. Latex enzymes were partially purified by salt or solvent precipitation.

Donato et al., (2014) observed study to isolate, identify and characterize the in vitro and in vivo adhesion of Lactobacillus strains isolated from birds.

Mangal et al., (2014) observed that the attempts were made to utilize papain enzyme for the stabilization of rice bran. Rice bran was treated with different concentrations of papain. Experiments were conducted using Response Surface Methodology.

Joshi (2015) examined the extraction of papain enzyme from ripe papaya gives around 80-90% activity. Lumps formations and absorptiometry methods were studied to know the action of papain enzyme. The efficacies of the enzymatic activities were checked when drugs were analyzed by TLC, spectrophotometer before and after the treated with papain enzyme.

Maskey and Shrestha (2020) revealed that the papaya latex as a source of crude papaya protease may have potential application to manufacture soft-unripened cheese and further could be utilized as a milk coagulant in cheese making.

Roha et al., (2022) conducted a study to optimize the yield and viscosity of soft cheese by papain using response surface methodology (RSM) and to determine the physicochemical and textural properties of soft cheese.

Maskey and Karki (2022) study aim to determine the potential of kiwifruit milk clotting enzyme in cheesemaking. The study highlighted that kiwifruit protease has ability to be used as efficient milk clotting enzyme in fresh cheese making.

CHAPTER IV
MATERIALS AND METHODS

4 .MATERIALS AND METHODS

✧ MATERIALS AND EQUIPMENTS:

1. **Sample plants:** *Carica papaya* and *Moringa oleifera* leaves powder.
2. **Chemicals and reagents:** Acetic acid, Ammonium sulphate [$(NH_4)_2SO_4$], Calcium chloride ($CaCl_2$), Disodium phosphate (Na_2HPO_4), Potassium dihydrogen phosphate (KH_2PO_4), Trichloroacetic acid, Sodium acetate, Sodium chloride, Sodium hydroxide, Casein, Antibiotics.

   Crystal violet, Gram's iodine, Safranin, Kovac's reagent, Methyl red indicator, ethanol, Barrit's A and Barrit's B reagent, Hydrogen peroxide.
3. **Sugars:** Glucose, Sucrose, Lactose, Mannitol.
4. **Media:** Nutrient broth, nutrient agar, Lactobacillus MRS Agar, Glucose phosphate broth, cimmon's citrate agar, triple sugar iron agar.
5. **Instruments:** Centrifuge, portable pH Meter, coloriometer.

✧ EXPERIMENTAL METHODS:

1. EXTRACTION OF MILK CLOTTING ENZYME:-

1) Sample collection:

- The leaves of the following plants *Carica papaya* and *Moringa oleifera* were collected from the botanical garden.
- The collected leaves were washed with running tap water to avoid surface contaminants and shade dried for about 7 days.
- The dried leaves were coarsely grounded using an electric grinder into a powder and kept in a polyethylene bags at 4°C for further use.

Figure 4: Dried papaya and drumstick powder.

2) Enzyme extraction:

- The crude extract were prepared from *Carica papaya* and *Moringa oleifera* dried leaves powder by using different extracting buffers which described previously (Ahmed et al., 2009).
- The sample of 20g of both *Carica papaya* and *Moringa oleifera* powder were immersed in 200ml of of 1M sodium acetate buffer (pH 5.0).
- The procedure of extraction was carried out for 24 hrs at 4°C.
- Then, the filtered extract were centrifuged at 5000×g for 20 minutes.
- The clear supernatant was collected and used for further enzyme purification process.

Figure 5 : Papaya and drumstick powder in sodium acetate buffer.

- **Calculations:**

$$\text{MCA}\left(\frac{\text{U}}{\text{ml}}\right) = \frac{2400 \times V_S}{T \times V_E}$$

Where, T = Time taken for formation of clots (s).

V_S = Volume of milk (ml).

V_E = Volume of enzyme (ml).

5) Proteolytic assay:

The proteolytic activity was measured by a modification of (Tomarelli et al., 1949) and (Neilier Junior 2020). In a proteolytic assay, the amount of substrate was measured (in this case, casein) that has been cleaved by the protease enzyme. The cleaved products usually have a different color or absorbance properties compared to the intact substrate.

- **Procedure:**

- The series of test tubes were labelled as a **blank** and **test** to perform proteolytic assay.
- In each tubes, initially 750µl of (100mM) phosphate buffer, (pH 6.3) and 2.0% (w/v) casein were added in both the test tubes.
- The mixtures were mixed well and equilibrated at the 55°C temperature for 10 minutes.
- Then add 300 µl of the sample (enzyme source) in only **'test'** labelled tube.
- The reaction mixtures were mixed well and incubated at a usually (37°C) for a specific time period. The incubation time may vary depending on the enzyme being assayed.
- 1ml aliquot of solution were removed from both the test and blank solution and placed into 2ml microtubes.
- Again, a 1000 µl Trichloroacetic acid was added in both the test tubes.
- The reaction mixture were centrifuged at 20,000g for 10 minutes and again 1ml aliquot of solution were removed from both the test and blank solution and placed into 2ml microtubes.
- Then, 1000µl of sodium hydroxide was added in both the test tubes.

3. CHEESE PRODUCTION FROM EXTRACTED ENZYME:-

- The commercially available fresh milk was purchased from a local market.
- Approximately 100ml of the fresh milk was heated upto 50°C for each experiment and cooled, then 15-20 drops of calcium chloride ($CaCl_2$) were added by continuous stirring.The milk was allow to stand for 10 minutes.

a) b)

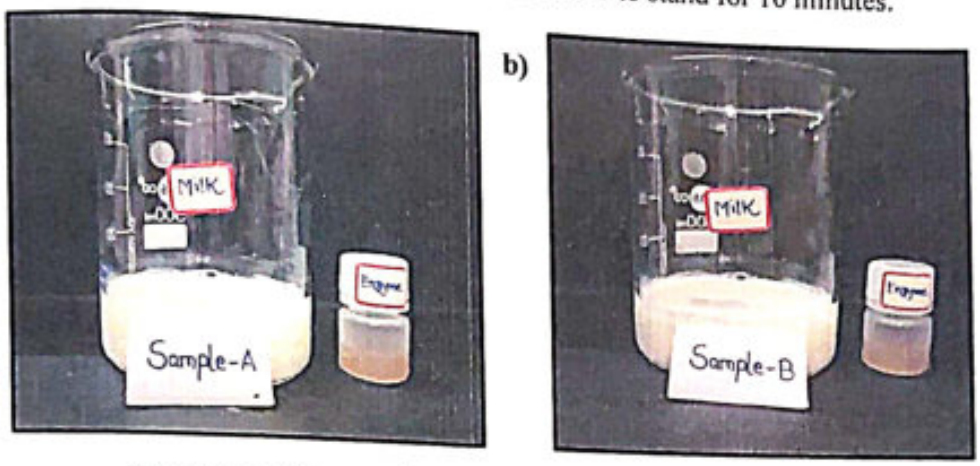


Figure 6: a) Preparation of cheese from *Carica papaya*.
b) Preparation of cheese from *Moringa oleifera*.

- 0.2g of starter culture (Thermophile B cheese culture) was added with continuous stirring and the milk was allowed to ripen for atleast 1 hr to develop acidity.
- The purified papain enzymes which were extracted earlier poured into a milk by dissolving in distilled water.
- Then the milk were incubated at a desired temperature for 30-50°C without stirring and left until coagulation completed.
- The coagulated milk were poured into muslin cloth and let it drained about for 1 hr and was allowed to ripen for 1 week at a desired temperature of 7-8°C.

4. ISOLATION AND IDENTIFICATION OF PROBIOTIC BACTERIA:

Ingredients	g/L
Protease peptone	10.000
HM Peptone B#	10.000
Yeast extract	5.000
Dextrose(Glucose)	20.000
Tween 80 (Polysorbate)	1.000
Ammonium citrate	2.000
Sodium acetate	5.000
Magnesium sulphate	0.100
Mangenese sulphate	0.050
Dipotassium hydrogen phosphate	2.000
Agar	12.000
Final pH (at 25°C)	6.5±0.2

Table 1: Composition of Lactobacillus MRS Agar medium.

C. **Carbohydrate fermentation tests:**

- The carbohydrate fermentation test helped determine the ability of bacteria to ferment specific carbohydrates, aiding in bacterial identification. Utilization of carbohydrates were determined as per Forouhandeh et al., (2010).
- This test involved inoculating various carbohydrate broths. Here, four carbohydrate broths were used such as glucose, sucrose, lactose and mannitol). The pH indicators are required to detect the production of acid so bromothymol blue is used here.
- These four broths were then incubated. After incubation, observations were made for changes in the broth, such as gas production (indicated by bubbles) and pH indicator changes (red for acid production, yellow for alkaline).

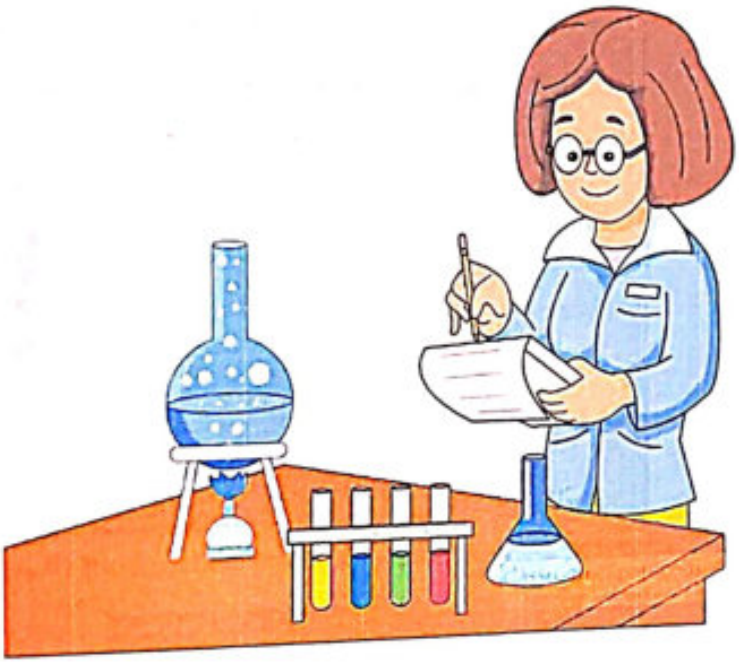
D. **Urea hydrolysis test:**

- The urease test detects the presence of the enzyme urease in bacterial cultures. Urease hydrolyzes urea to produce ammonia and carbon dioxide, leading to an increase in pH.
- The urease test involved inoculating urea agar slants and then incubated.
- After incubation, observations were made for a color change in the agar, typically from yellow to pink or magenta. This reaction helped differentiate urease-positive bacteria from urease-negative ones, aiding in bacterial identification.

E. **Catalase test:**

- The catalase test confirmed the ability of the bacteria to break down hydrogen peroxide into water and oxygen, aiding in bacterial identification.
- This slide test reaction performed that involved transferring a small amount of bacterial growth to a clean glass slide using a sterile loop.
- Then, a drop of hydrogen peroxide was added to the bacterial growth.
- Observations were made for the immediate release of bubbles, indicating the presence of catalase enzyme activity.

CHAPTER V
RESULTS



2. Milk clotting activity:

The results of the present study evaluated that the milk clotting activity was only detected in the crude leaf extract of *Carica papaya* plant which is nothing but a papain enzyme and the crude enzyme extracted from a *Moringa oleifera* leaves failed to showed the milk clotting activity. The following table represented the milk clotting activity of the above study.

Sr. No	Sample	TOC(sec)	MCA (U/ml)
1.	*Carica papaya*	176 sec	136 U/ml
2.	*Moringa oleifera*	ND	ND

Table 3: The milk clotting activity of the purified enzymes.

3. Proteolytic assay:

In this proteolytic assay, the amount of substrate of casein were measured that has been cleaved by the protease enzyme. The colour change was observed in both the extracted milk clotting enzymes as a yellow coloured solution.

Sr. No	Sample	O.D of Blank	O.D of Test	ΔA_{440nm}
1.	*Carica papaya*	0.18	0.41	0.23
2.	*Moringa oleifera*	0.10	0.15	0.05

Table 4: Absorbance of milk clotting enzymes at 440nm.

By observing the above (Table 4), it were reported that the absorbance of the solution increased and the proteolytic activity of papain enzyme which were extracted from *Carica papaya* showed the highest enzyme activity as compared to *Moringa oleifera*.

a) b)

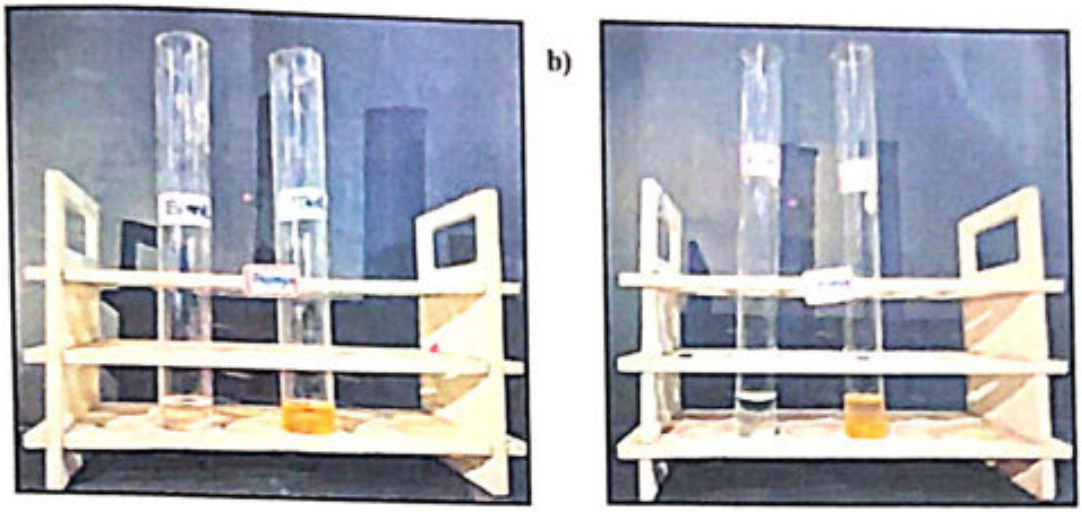


Figure 9 : a) Proteolytic assay of enzyme from *Carica papaya*.
b) Proteolytic assay of enzyme from *Moringa oleifera*.

A positive value of ΔA_{440nm} evaluated by subtracting the absorbance of the blank sample from the absorbance of the test sample, this indicated that more substrate has been cleaved by the protease enzyme in the test sample compared to the blank.

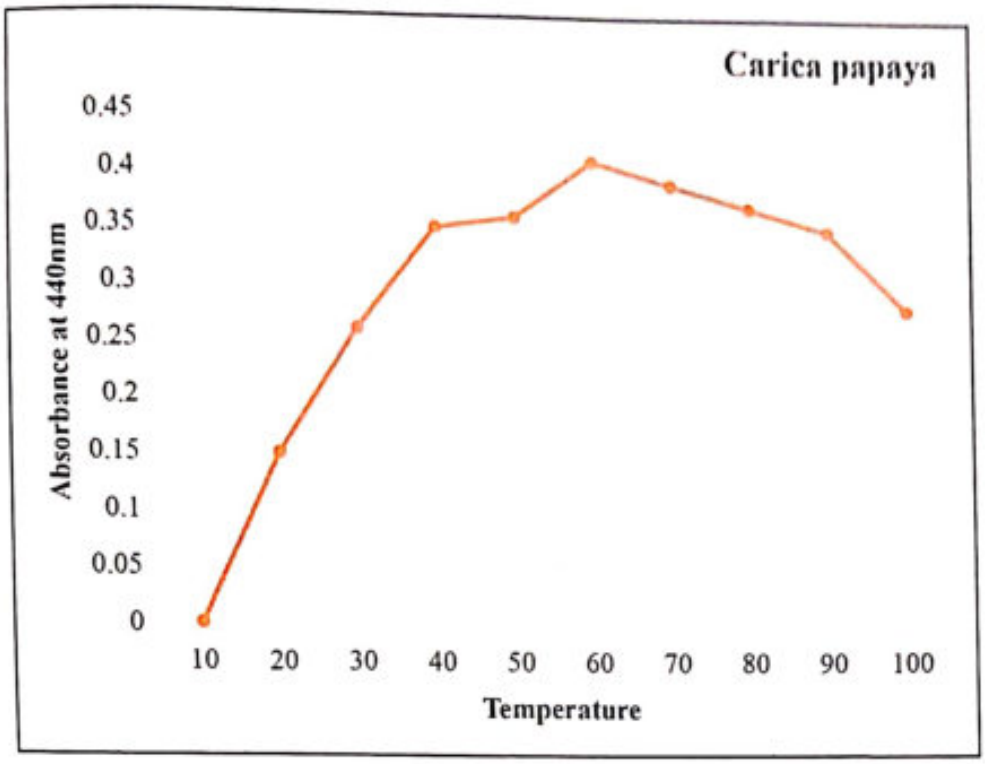
4. Characterization of extracted purified enzyme:

❖ Effect of temperature on the activity of enzymes:

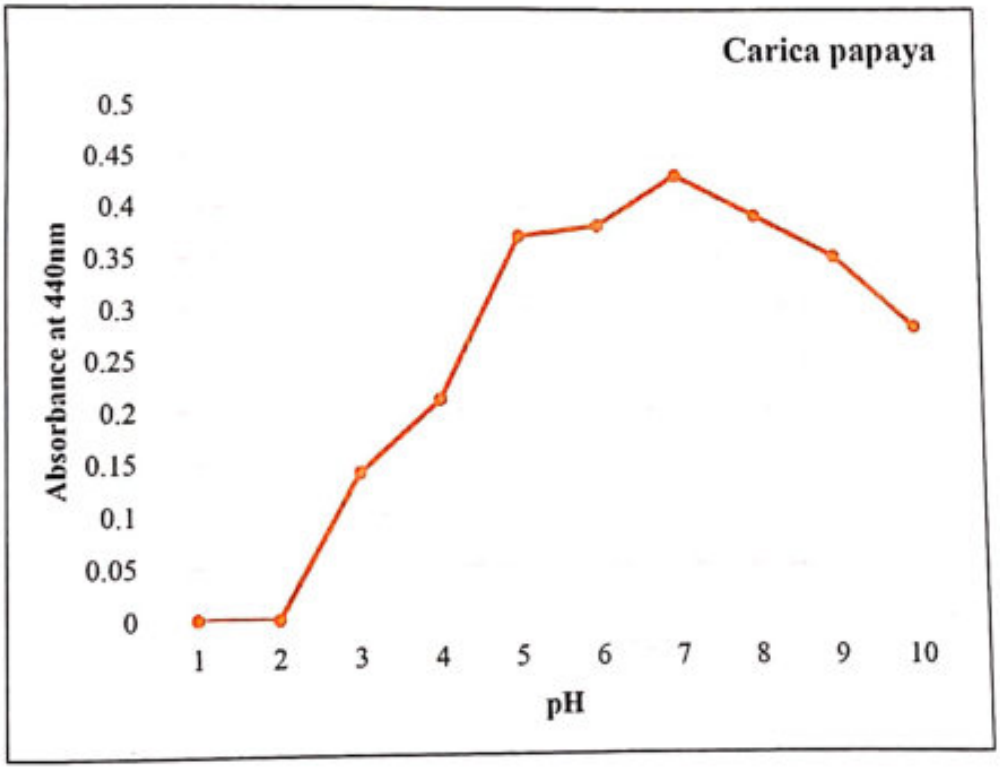
The plant based protease enzyme production by the leaves of *Carica papaya* which were taken at various incubation periods ranging between 10°C to 100°C. Graph 1 showed that the maximum activity of *Carica papaya* and the optimum temperature of papain enzyme at 60°C with 0.42 absorbance at 440nm.

❖ Effect of pH on the activity of enzymes:

The plant based protease enzyme production by the leaves of *Carica papaya* which was tested at different pH range of 0-10.0. The pH dependence of protease that is papain enzyme showed in graph 2, the optimum pH was found at pH 7.0 with 0.43 absorbance at 440nm.



Graph 1. Effect of temperature on purified papain enzyme.



Graph 2. Effect of pH on purified papain enzyme.

5. Cheese production:

The results of the present study stated that cheese was produced by an milk clotting enzyme or papain enzyme extracted and purified from *Carica papaya* due to its highest activity. On the other hand, enzyme extracted from *Moringa oleifera* had failed to produced cheese.

a) b)

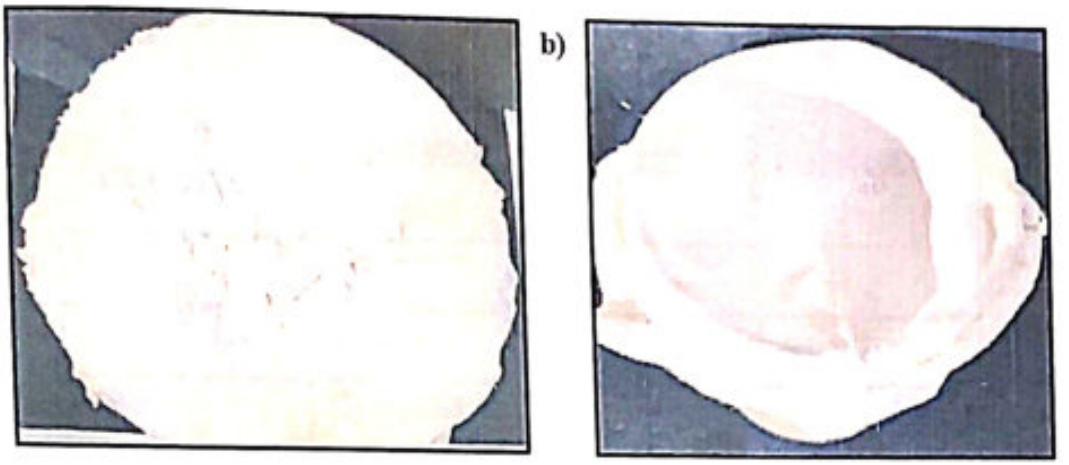


Figure 10 : a) Drained cheese curd produced from *Carica papaya*.
b) Cheese curd failed to produced from *Moringa oleifera*.

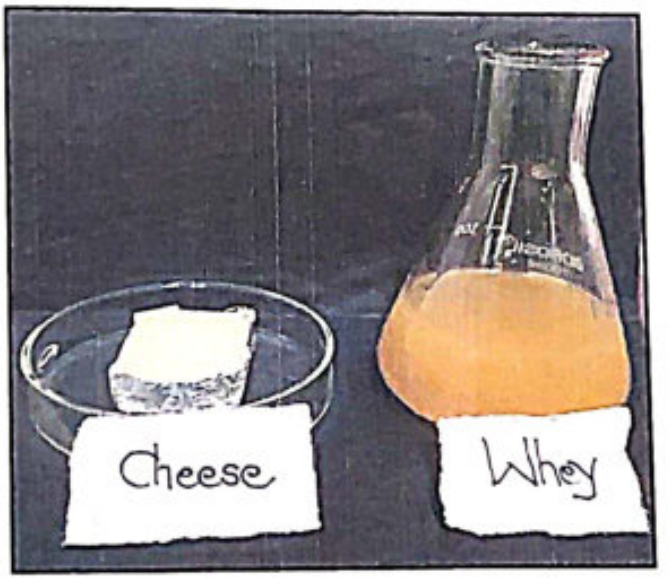


Figure 11: The seperated whey and a cheese.

3) Morphological and biochemical characterization:

Sr. No	Gram staining	Motility	Biochemical tests				TSI			Carbohydrate fermentation				Enzymes		Name of organisms
			I	M	V	C	S	B	H_2S	G	S	L	M	U	Ca	
1.	Gram Positive	Non-motile	–	–	–	–	–	–	–	A	A	A	–	–	–	*Lactobacillus spp.*
2.	Gram Positive	Non-motile	–	+	–	–	–	–	–	AG	A	A	–	+	–	*Bifidobacterium spp.*
3.	Gram Positive	Non-motile	–	–	–	–	–	–	–	A	–	AG	–	+	–	*Lactococcus spp.*

Table 6: Morphological and biochemical characterization of bacterial isolates.

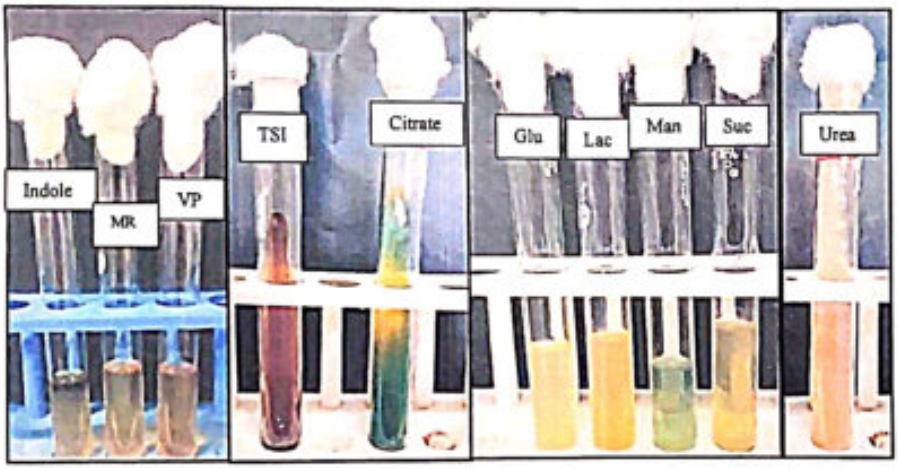


Figure 13: Biochemical test for bacterial isolate-1.

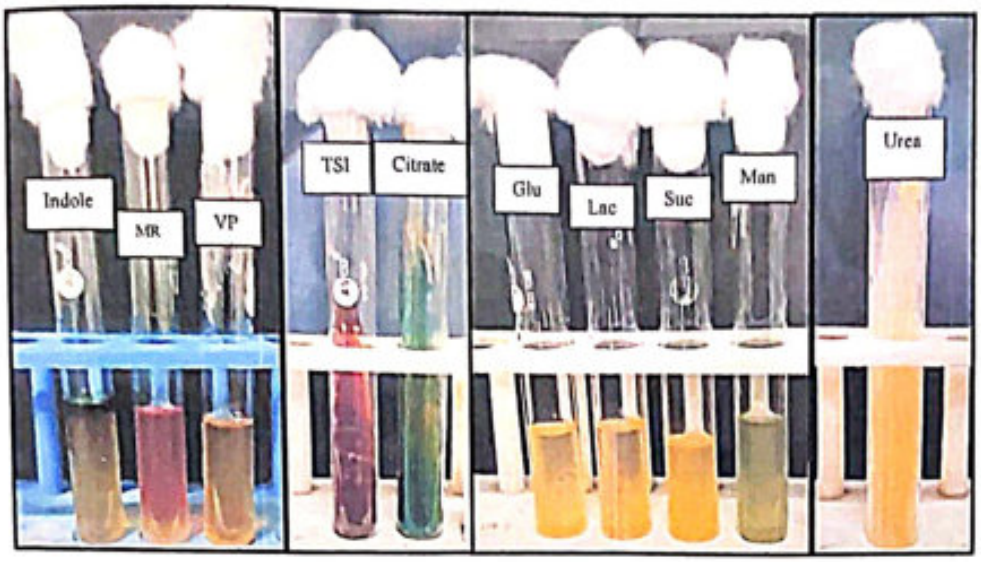


Figure 14: Biochemical test for bacterial isolate-2

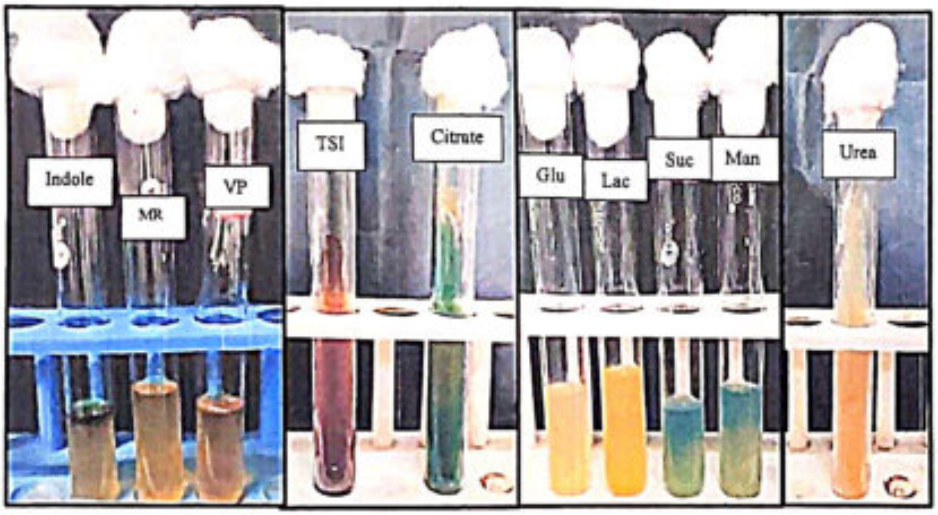


Figure 15: Biochemical test for bacterial isolate-3.

4) Antibiotic resistance profile:

Sr. No	Organism	CIP	STR	TE	TOB	Va	E	Ox	AMP	R	S
1.	*Lactobacillus spp*	29	4	24	21	10	15	31	12	0	8
2.	*Bifidobacterium spp.*	16	19	2	13	7	26	5	4	0	8
3.	*Lactococcus spp.*	28	3	12	21	22	18	16	14	0	8
	Resistance	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**		
	Sensitive	**3**	**3**	**3**	**3**	**3**	**3**	**3**	**3**		

Table 7: Antibiotic Susceptibility Test of isolated bacteria.

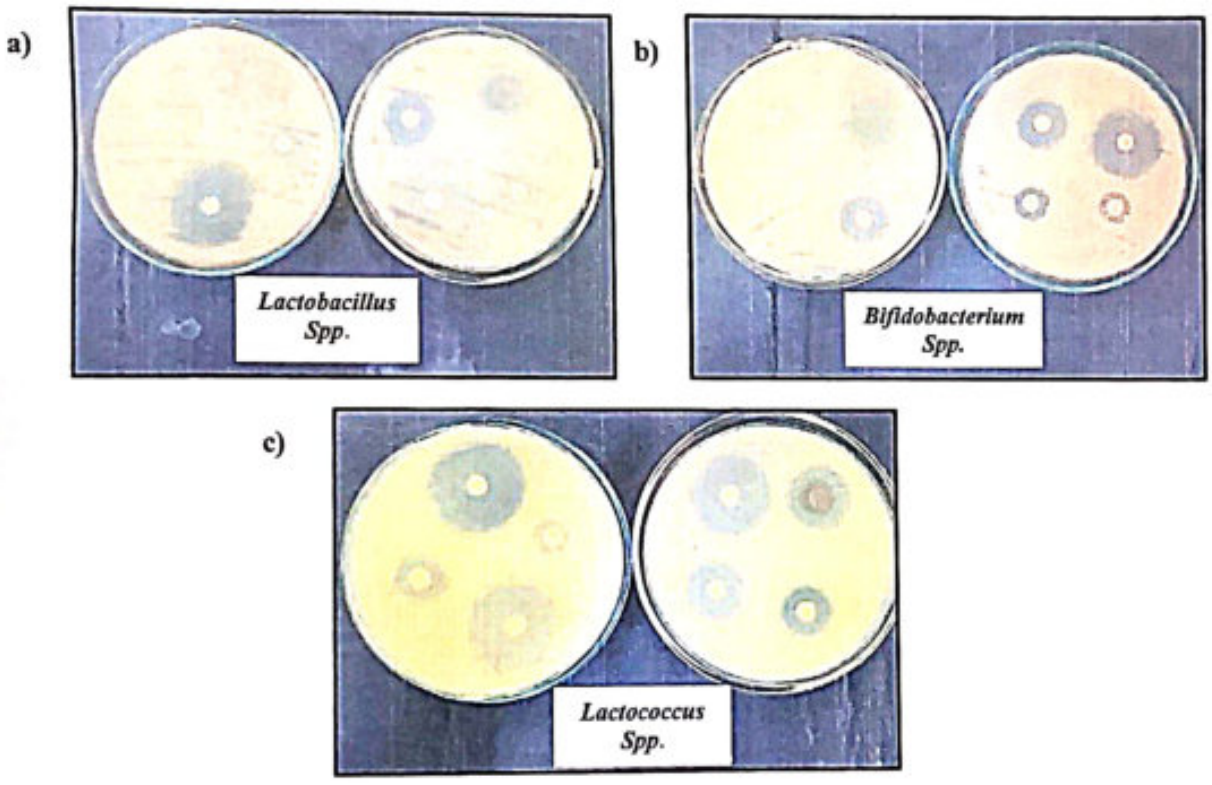


Figure 16: Representation of antibiotic susceptibility test against three bacterial isolates.

CHAPTER VI
DISCUSSION

6. DISCUSSION

The present study was conducted to the extraction of milk clotting enzymes in which (Figure 7) showed the crude enzyme which were isolated from plants were purified and the purified enzyme were found in (Figure 8). The results investigated in (Table 3) that the milk clotting enzyme which was extracted from *Carica papaya* leaves having highest milk clotting activity and enzyme extracted from *Moringa oleifera* failed to show its activity.

The proteolytic assay of the extracted enzyme showed the activity of enzyme by observing their colour of test sample which showed as a yellow and difference between the absorbance of both blank and test sample at 440nm showed by (Table 4) when the casein was used as a substrate at room temperature to carry out reaction (Figure 9) and which agreed with the study of (Tomarelli et al., 1949).

In the characterization of extracted enzyme, it were evaluated that the maximum activity or optimum temperature of papain enzyme reached at 60°C and at pH 7.0 the papain enzyme showed it's maximum or excellent activity which were represented by Graph 1 and Graph 2. The results were near about complied with (Derso and Dagnew 2019) and (Hullikere et al., 2014).

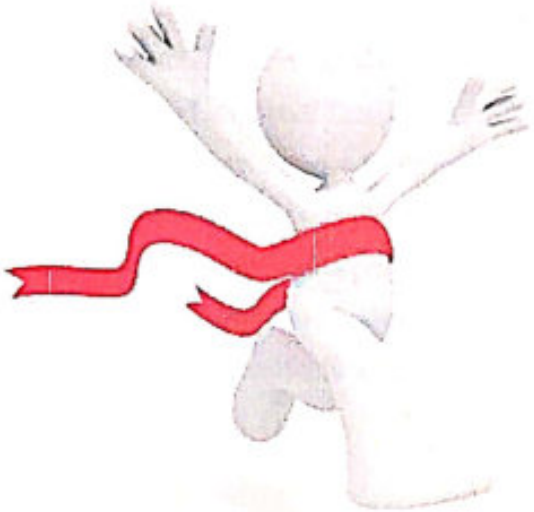
The production of cheese was only accomplished by a enzyme of *Carica papaya* which officially referred as papain enzyme as in (Figure 10). The results is not fully in agreement with the work of (Derso and Dagnew 2019) where they found that both milk clotting enzyme from *Carica papaya* and *Moringa oleifera* showed highest clotting activity which were capable in the preparation of cheese.

In the study of isolation of probiotic bacteria, three bacterial isolates (Figure 12) were isolated from the produced cheese sample, which were nothing but a lactic acid bacteria's. By observing the several test including morphological, cultural and biochemical characterization of bacterial isolates, it investigated that the bacteria which were found in this present research work were *Lactobacillus spp.*, *Bifidobaterium spp.* and *Lactococcus spp* (Table 6). The isolates were capable of

fermenting different sugars used i.e. glucose, fructose, sucrose, lactose and mannitol which indicates their broad range potential to utilize different carbohydrates for their growth. The findings of the study of (Dinakar and Mistry 1994) and (Martin et al., 2003) significantly implemented with this project work.

The major aim of using these probiotic bacteria's should be to affect beneficially the gut microbial composition and activities. Hence, in the present study, when the selected three bacterial isolates were also tested for their antibiotic resistance profile, to all of the eight antibiotics which used (Table 7). These were found that only few antibiotics showed low resistance in which streptomycin having low resistance to *Lactobacillus spp.* And *Lactococcus spp.* The *Bifidobacterium spp.* evaluated that tetracycline, Vancomycin, Oxacillin and ampicillin showed low resistance.

CHAPTER VII
CONCLUSION



7. CONCLUSION

In the field of biotechnology and food science, the extraction of milk clotting enzymes from plants and the isolation of probiotic bacteria stand as pivotal advancements. The process of extracting milk clotting enzymes from plants presents a sustainable and economically viable alternative to animal-derived rennet, a substance traditionally used in cheese-making. Simultaneously, the isolation and identification of probiotic bacteria hold immense promise for enhancing the nutritional value and health benefits of dairy products. By isolating strains of *Lactobacillus* and *Bifidobacterium* with probiotic potential from diverse sources such as fermented dairy products and the human gut microbiome, researchers have widened the scope of functional foods.

Furthermore, the synergy between plant-derived milk clotting enzymes and probiotic bacteria opens avenues for the development of novel dairy products with enhanced nutritional profiles and improved functional properties. The combination of plant-derived enzymes for milk coagulation with selected probiotic strains offers the potential to create cheeses and dairy beverages with improved texture, flavor, and health-promoting attributes. This symbiotic approach not only aligns with the growing consumer demand for natural, plant-based alternatives but also underscores the importance of functional foods in promoting human health and well-being.

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Shri Shivaji Education Society Amravati's

Science College, Congress Nagar, Nagpur

Environmental Studies project/ field hand book

Topic: Biodiversity

Session: 2023-2024

Submitted To: Ms. P B Zamarkar

Submitted By: Akshita P Mohadikar

Shri Shivaji Education Society Amravati's

Science College

Congress Nagar, Nagpur

Certificate

This is to Certify that the Environmental Studies project/ field hand book written is satisfactorily performed by Mr/Miss Akshidei Mohadikar Class B.Sc. Section _____ Batch _____ during the academic session 2023 - 2024.

5/03/2024
Date

Nagpur
Place

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DECLARATION

I, the undersigned hereby declare that the project/ field hand book entitled Biodiversity has been carried out under the guidance and supervision of Dr P. B. Zamarkar, Assistant Professor & Convener and Dr. R. P. Sonwalkar, Assistant Professor & Co convener, SSESA's Science College, Congress Nagar, Nagpur.

This work has been collected from different sources and has not submitted to any other University/ Institution for the award of any degree and diploma.

Place: Nagpur

Date: 5/03/2024

Akshita P Mohadikar

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Date:

Place: Nagpur

Akshita P Mohadikar

Table of Content

Subtopic : INTRODUCTION – DEFINITION: GENETIC, SPECIES, ECOSYSTEM DIVERSITY.

Introduction :

The great variety of life on earth has provided for man's needs over thousands of years. This diversity of living creatures forms a support system which has been used by each civilization for its growth and development. Those that used this "bounty of nature" carefully and sustainably survived. Those that overused or misused it disintegrated. Science has attempted to classify and categorize the variability in nature for over a century. This has led to an understanding of its organization into communities of plants and animals. This information has helped in utilizing the earth's biological wealth for the benefit of humanity and has been integral to the process of 'development'. This includes better health care, better crops and the use of these life forms as raw material for industrial growth which has led to a higher standard of living for the developed world. However this has also produced the modern consumerist society, which has had a negative effect on the diversity of biological resources upon which it is based. The diversity of life on earth is so great that if we use it sustainably we can go on developing new products from biodiversity for many generations. This can only happen if we manage biodiversity as a precious resource and prevent the extinction of species.

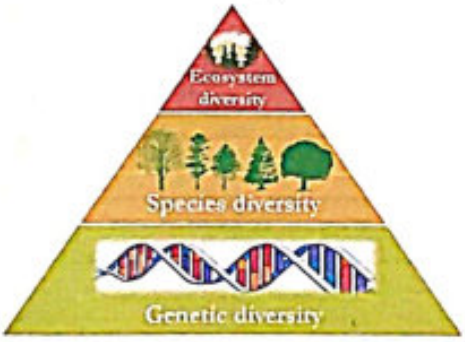
Definition:

'Biological diversity' or biodiversity is that part of nature which includes the differences in genes among the individuals of a species, the variety and richness of all the plant and animal species at different scales in space, locally, in a region, in the country and the world, and various types of ecosystems, both terrestrial and aquatic, within a defined area.

What is biodiversity?

Biological diversity deals with the degree of nature's variety in the biosphere. This variety can be observed at three levels; the genetic variability within a species, the variety of species within a community, and the organisation of species in an area into distinctive plant and animal communities constitutes ecosystem diversity.

Genetic diversity



Each member of any animal or plant species differences widely from other individuals in its genetic makeup because of the large number of combinations possible in the genes that give every individual specific characteristics. Thus, for example, each human being is very different from all others. This genetic variability is essential for a healthy breeding population of a species. If the number of breeding individuals is reduced, the dissimilarity of genetic makeup is reduced and in-breeding occurs. Eventually this can lead to the extinction of the species. The diversity in wild species forms the 'gene pool' from which our crops and domestic animals have been developed over thousands of years. Today the

variety of nature's bounty is being further harnessed by using wild relatives of crop plants to create new varieties of more productive crops and to breed better domestic animals. Modern biotechnology manipulates genes for developing better types of medicines and a variety of industrial products.

Species diversity

The number of species of plants and animals that are present in a region constitutes its species diversity. This diversity is seen both in natural ecosystems and in agricultural ecosystems. Some areas are more rich in species than others. Natural undisturbed tropical forests have a much greater species richness than plantations developed by the Forest Department for timber production. A natural forest ecosystem provides a large number of non-wood products that local people depend on such as fruit, fuel wood,fodder, fiber, gum, resin and medicines. Timber plantations do not provide the large variety of goods that are essential for local consumption. In the long-term the economic sustainable returns from non-wood forest products is said to be greater than the returns from felling a forest for its timber. Thus the value of a natural forest, with all its species richness is much greater than a plantation. Modern intensive agricultural ecosystems have a relatively lower diversity of crops than traditional agro pastoral farming systems where multiple crops were planted. At present conservation scientists have been able to identify and categorise about 1.8 million species on earth. However, many new species are being identified, especially in the flowering plants and insects. Areas that are rich in species diversity are called 'hotspots' of diversity. India is among the world's 15 nations that are exceptionally rich in species diversity.

Ecosystem diversity

There are a large variety of different ecosystems on earth, which have their own complement of distinctive inter linked species based on the differences in the habitat. Ecosystem diversity can be described for a specific geographical region, or a political entity such as a country, a State or a taluka. Distinctive ecosystems include landscapes such as forests, grasslands, deserts,mountains, etc., as well as aquatic ecosystems such as rivers, lakes, and the sea. Each region also has man-modified areas such as farmland or grazing pastures. An ecosystem is referred to

as 'natural' when it is relatively undisturbed by human activities, or 'modified' when it is changed to other types of uses, such as farmland or urban areas. Ecosystems are most natural in wilderness areas. If natural ecosystems are overused or misused their productivity eventually decreases and they are then said to be degraded. India is exceptionally rich in its ecosystem diversity.

BIOGEOGRAPHIC CLASSIFICATION OF INDIA

Our country can be conveniently divided into ten major regions, based on the geography, climate and pattern of vegetation seen and the communities of mammals, birds, reptiles, amphibian, insects and other invertebrates that live in them. Each of these regions contains a variety of ecosystems such as forests, grasslands, lakes, rivers, wetlands, mountains and hills, which have specific plant and animal species. India's Biogeographic Zones

1. The cold mountainous snow covered Trans Himalayan region of Ladakh.
2. The Himalayan ranges and valleys of Kash-mir, Himachal Pradesh, Uttarakhand, Assam and other North Eastern States.
3. The Terai, the lowland where the Himalayan rivers flow into the plains.
4. The Gangetic and Bhramaputra plains.

5. The Thar Desert of Rajasthan.

6. The semi arid grassland region of the

Deccan plateau Gujarat, Maharashtra,

Andra Pradesh, Karnataka and Tamil Nadu.

7. The Northeast States of India,

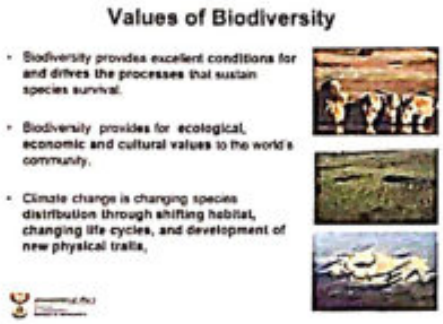
8. The Western Ghats in Maharashtra,

Karnataka and Kerala.

9. The Andaman and Nicobar Islands.

10. The long western and eastern coastal belt with sandy beaches, forests and mangroves.

VALUE OF BIODIVERSITY



Environmental services from species and ecosystems are essential at global, regional and local levels. Production of oxygen, reducing carbon dioxide, maintaining the water cycle, protecting soil are important services. The world now acknowledges that the loss of biodiversity contributes to global climatic changes. Forests are the main mechanism for the conversion of carbon dioxide into carbon and oxygen. The loss of forest cover, coupled with the increasing release of carbon dioxide and other gases through industrialization contributes to the 'greenhouse effect'. Global warming is melting ice caps, resulting in a rise in the sea level which will sub-merge the low lying areas in the world. It is causing major atmospheric changes, leading to increased temperatures, serious droughts in some areas and unexpected floods in other areas. Biological diversity is also essential for preserving ecological processes, such as fixing and re-cycling of

nutrients, soil formation, circulation and cleansing of air and water, global life support (plants absorb CO2, give out O2), maintaining the water balance within ecosystems, watershed protection, maintaining stream and river flows throughout the year, erosion control and local flood reduction. Food, clothing, housing, energy, medicines, are all resources that are directly or indirectly linked to the biological variety present in the biosphere. This is most obvious in the tribal communities who gather resources from the forest, or fisherfolk who catch fish in marine or freshwater ecosystems. For others, such as agricultural communities, biodiversity is used to grow their crops to suit the environment. Urban communities generally use the greatest amount of goods and services, which are all indirectly drawn from natural ecosystems. It has become obvious that the preservation of biological resources is essential for the well-being and the long-term survival of mankind. Thisdiversity of living organisms which is present wilderness, as well as in our crops and live-stock, plays a major role in human 'development'. The preservation of 'biodiversity' is therefore integral to any strategy that aims at improving the quality of human life.

BIODIVERSITY AT GLOBAL, NATIONAL AND LOCAL LEVELS

There are at present 1.8 million species knownand documented by scientists in the world. How-ever, scientists have estimated that the number of species of plants and animals on earth could vary from 1.5 to 20 billion! Thus the majority of species are yet to be discovered. Most of the world's bio-rich nations are in the South, which are the developing nations. In contract, the majority of the countries capable of exploiting biodiversity are Northern nations, inthe economically developed world. These nations however have low levels of biodiversity. Thus the developed world has come to support the concept that biodiversity must be considered to be a 'global resource'. However, if biodiversity should form a 'common property resource' to be shared by all nations, there is no reason to exclude oil, or uranium, or even intellectual and technological expertise as global assets. India's sovereignty over its biological diversity cannot be compromised without a revolutionary change in world thinking about sharing of all types of natural resources.

INDIA AS A MEGA DIVERSITY NATION

Geological events in the landmass of India have provided conditions for high levels of biological diversity. A split in the single giant continent round 70 million years ago, led to the formation of northern and southern continents, with India a part of Gondwanaland - the southern landmass, together with Africa, Australia and the Antarctic. Later tectonic movements shifted India ndia northward across the equator to join the Northern Eurasian continent. As the intervening shallow Tethis Sea closed down, plants and animals that had evolved both in Europe and in the Far East migrated into India before the Himalayas had formed. A final influx came from Africa with Ethiopian species, which, were adapted to the Savannas and semi-arid regions. Thus India's special geographical position between three distinctive centres of biological evolution and radiation of species is responsible for our rich and varied biodiversity. Among the biologically rich nations, India stands among the top 10 or 15 countries for its great variety of plants and animals, many of which are not found elsewhere. India has 350 different mammals (rated eight highest in the world),1,200 species of birds (eighth in the world), 453 species of reptiles (fifth in the world) and 45,000 plant species, of which most are angiosperms, (fifteenth in the world). These include especially high species diversity of ferns (1022 species) and orchids (1082 species). India has 50,000 known species of insects, including 13,000 butterflies and moths. It is estimated that the number of unknown species could be several times higher. It is estimated that 18% of Indian plants are endemic to the country and found nowhere else in the world. Among the plant species the flowering plants have a much higher degree of endemism, a third of these are not found elsewhere in the world. Among amphibians found in India, 62% are unique to this country. Among lizards, of the 153 species recorded, 50% are endemic. High endemism has also been recorded for various groups of insects, marine worms, centipedes, mayflies and fresh water sponges.

HOTSPOTS OF BIODIVERSITY

Conservation International (conservation.org) defines 35 biodiversity hotspots — extraordinary places that harbor vast numbers of plant and animal species found nowhere else. All are heavily threatened by habitat loss and degradation, making their conservation crucial to protecting nature for the benefit of all life on Earth.

The earth's biodiversity is distributed in specific ecological regions. There are over a thousand major ecoregions in the world. Of these, 200 are said to be the richest, rarest and most distinctive natural areas. These areas are referred to as the Global 200. It has been estimated that 50,000 endemic plants which comprise 20% of global plant life, probably occur in only 18 'hot spots' in the world. Countries which have a relatively large proportion of these hot spots of diversity are referred to as 'mega diversity nations'. The rate at which the extinction of species is occurring throughout our country remains obscure. It is likely to be extremely high as our wilderness areas are shrinking rapidly. Our globally accepted national 'hot spots' are in the forests of the North-East and the Western Ghats, which are included in the world's most bio rich areas. The Andaman and Nicobar Islands are extremely rich in species and many subspecies of different animals and birds have evolved. Among the endemic species i.e. those species found only in India, a large proportion are concentrated in these three areas. The Andaman and Nicobar Islands alone have as many as 2200 species of flowering plants and 120 species of ferns. Out of 135 genera of land mammals in India, 85 (63%) are found in the Northeast. The Northeast States have 1,500 endemic plant species. A major proportion of amphibian and reptile species, especially snakes,

are concentrated in the Western Ghats, which is also a habitat for 1,500 endemic plant species. Coral reefs in Indian waters surround the Andaman and Nicobar Islands, Lakshadweep Islands, the Gulf areas of Gujarat and Tamil Nadu. They are nearly as rich in species as tropical evergreen forests!

THREATS TO BIODIVERSITY: HABITAT LOSS, POACHING OF WILDLIFE, MAN-WILDLIFE CONFLICTS.

Man has begun to overuse or misuse most of these natural ecosystems. Due to this 'unsustainable' resource-use, once productive forests and grasslands have been turned into deserts and wasteland have increased all over the world. Mangroves have been cleared for fuelwood and prawn farming, which has led to a decrease in the habitat essential for breeding of marine fish. Wetlands have been drained to increase agricultural land. These changes have grave economic implications in the longer term.

There are about 1.8 million species of plants and animals, both large and microscopic, known to science in the world at present. The number of species however is likely to be greater by a factor of at least 10. Plants and insects as well as other forms of life not known to science are continually being identified in the worlds' 'hotspots' of diversity. Unfortunately at the present rate of extinction about 25% of the worlds' species will undergo extinction fairly rapidly. This may occur at the rate of 10 to 20 thousand species per year, a thousand to ten thousand times faster than the expected natural rate! Human actions could well exterminate 25% of the world's species within the next twenty or thirty years. Much of this mega extinction spasm is related to human population growth, industrialization and changes in land-use patterns. A major part of these extinctions will occur in 'biorich' areas such as tropical forests, wetlands, and coral reefs. The loss of wild habitats due to rapid human population growth and short term economic development are major contributors to the rapid global destruction of biodiversity.

Loss of species occurs due to the destruction of natural ecosystems, either for conversion to agriculture or industry, or by over-extraction of their resources, or through pollution of air, water and soil.

In India, forests and grasslands are continuously being changed to agricultural land. Encroachments have been legalized repeatedly. Similarly natural wetland

systems have been drained to establish croplands resulting in loss of aquatic species. Grasslands that were once sustainably used by a relatively smaller number of human beings and their cattle are either changed to other forms of use or degraded by overgrazing.

Our natural forests are being deforested for timber and replanted using teak, sal or other single species for their timber value. Such plantations do not support the same biological diversity as a multi-storied natural forest, which has a closed canopy and a rich understorey of vegetation. When excessive firewood is collected from the forest by lopping the branches of trees, the forest canopy is opened up and this alters local biodiversity. Foraging cattle retard the regeneration of the forest as seedlings are constantly trampled. Increasing human population on the fringes of our Protected Areas degrade forest ecosystems. This is a major factor to consider in evaluating the quality of the ecosystem. Repeated fires started by local grazers to increase grass growth ultimately reduces regeneration and lowers the diversity of plant species. Without alternate sources of fodder this pressure cannot be decreased.

In our country a variety of traditional farming techniques have evolved over several centuries. Cultivation by slash and burn in the Himalayas, and 'rab' by lopping of tree branches to act as a wood-ash fertilizer in the Western Ghats, are two such systems. When human population in these areas was low, these were sustainable Biodiversity methods of agriculture. Unfortunately these areas now have a large number of people who subsist largely on forest agriculture. These methods are now unsustainable and are leading to a loss of forest biodiversity.

Poaching: Specific threats to certain animals are related to large economic benefits. Skin and bones from tigers, ivory from elephants, horns from rhinos and the perfume from the must deer are extensively used abroad. Bears are killed for their gall bladders. Corals and shells are also collected for export or sold on the beaches of Chennai and Kanyakumari. A variety of wild plants with real or at times dubious medicinal value are being over harvested. The commonly collected plants include Rauvolfia, Nuxvomica, Datura, etc. Collection of garden plants includes orchids, ferns and moss.

ENDANGERED AND ENDEMIC SPECIES OF INDIA

To appreciate the endemic and endangered species of India it is important to understand the wide variety of plant and animal species that are found in the country. Of the well-known species, there are several which are endangered by human activity. The endangered species in the country are categorised as Vulnerable, Rare, Indeterminate and Threatened. Other species are found only in India and are thus endemic or restricted to our country. Some of these may have very localized distribution and are considered highly endemic.

Several plant and animal species in the country are now found in only one or a few Protected Areas. Among the important endangered animals are charismatic species such as the tiger, the elephant, the rhino, etc. The less well-known major mammals restricted to a single area include the Indian wild ass, the Hangul or Kashmir stag, the Golden langur, the pygmy hog and a host of others. There are also endangered bird species such as the Siberian crane, the Great Indian Bustard, the Florican and several birds of prey. During the recent past, vultures which were common a decade ago, have suddenly disappeared and are now highly threatened. Equally threatened are several species of reptiles and amphibia. Many invertebrates are also threatened, including a large number of species that inhabit our coral reefs. Many plant species are now increasingly threatened due to changes in their habitats induced by human activity. Apart from major trees, shrubs and climbers that are extremely habitat specific and thus endangered, there are thousands of small herbs which are greatly threatened by habitat loss. Several orchids are yet another group of plants that are under threat. Many plants are threatened due to overharvesting as ingredients in medicinal products. To protect endangered species India has created the Wildlife Protection Act.

This includes lists of plants and animals categorised according to the threat on their survival. We know so little about the species diversity of our country. There are several groups of which we know very little. Most of us are only aware of the plight of a few glamorous large mammals, but we need to appreciate the threat to the less known species of plants and animals. We need to find ways to support the conservation of our incredible wildlife for future generations.

Common Plant species

Teak: This tree is from the Southwest parts of peninsular India. It is a common tree in deciduous forests. It yields a much sought after timber used for making excellent furniture. During the early British period it was cut down from many forest tracts to build ships. As the stocks were diminishing, the British selected areas which they called Reserved Forests where teak was planted for the Government's use. Teak is grown extensively by the Forest Department and is a highly priced wood. The teak tree is identified by its large leaves, which grow to more than 40 or 50cms long and 20cms wide. It has tiny flowers and fruit. In the winter, the trees shed all their leaves. In the growing season, which begins in April and extends through the monsoon, teak forests are bright green and shady.

Most natural teak forests have various other species of plants and have a large number of wild animals. Some areas of teak forests that have exceptional populations of wildlife have been included in our National Parks and Wildlife Sanctuaries.

Sal: This is a common species of several types of forests of the Northeastern region of India, extending into Madhya Pradesh and Orissa. It has bright green foliage and its canopy remains green nearly throughout the year. Sal wood is hard and durable. Sal gets a large number of seeds which are used in making cosmetics. The sal forests are rich in wild mammals, birds, reptiles and insect life. Several areas are included in our network of National Parks and Sanctuaries.

Flame of the Forest (Butea monosperma): This tree grows in many parts of India. It has bright orange flowers when it is leafless, thus it is called 'flame of the forest'. The flowers are full of nectar which attracts monkeys and many nectar dependent birds.

Coral Tree (Erythrina): A common deciduous tree that is leafless in February when it gets bright scarlet flowers that are used for their nectar by many birds such as mynas, crows and sunbirds, that act as its major pollinators. Its long black seed pods contain several shiny brown seeds which germinate well. This tree can also be propagated by cutting and planting its young branches. It is a rapid grower and usually begins to flower in four or five years time.

Dipterocarps: This group of trees grows in evergreen forests of the southern part of the Western Ghats and in the Northeast of India, in high rainfall areas. It grows to an enormous height with a wide girth. The seed has a pair of wing like structures which aid in wind dispersal.

Common Animal species

Mammals: The common deer species found in India include the sambar, chital, barasingha and barking deer. Sambar live in small family parties especially in hilly forested areas and feed mainly on shrubs and leaves of low branches. They are dark brown in colour and have large thick antlers, each having 3 branches. **Chital or spotted deer** live in large herds in forest clearings where they graze on the grass. They have a rust brown body with white spots which camouflages them in the forest. Each antler has three branches called tines.
The rare Hangul deer is found only in Kashmir. It has a magnificent spread of antlers with 6 branches on each antler. The Barasingha, or swamp deer, has wide hoofs that enable this beautiful animal to live in boggy areas of the Terai. Each antler has 6 or more branches. The tiny barking deer lives in many forest areas all over India. It has two ridges on its face and a short antler with only 2 branches. Its call sounds like the bark of a dog. **The blackbuck** is the only true antelope found in India. It lives in large herds. The males are black on top and cream below and have beautiful spiral horns that form a 'V' shape. The chinkara, also known as the Indian gazelle, is a smaller animal and is pale brown in colour it has beautiful curved horns. The rare **Chausingha**, or **four horned antelope**, is the only animal in the world that has four horns.
The nilgai is the largest of the dryland herbivores. The males are blue-gray. Nilgai have white markings on the legs and head. They have short strong spike-like horns. A very special rare species is the **Indian wild ass,** endemic to the Little Rann of Kutch. Himalayan pastures support several species of wild goats and sheep, many of them restricted to the region, like the goral and the Himalayan tahr. A single species, the Nilgiri tahr is found in the Nilgiri and Annamalai hills in south India.
The **rhinocerous** is now restricted to Assam but was once found throughout the Gangetic plains. The wild buffalo is now also restricted to the Terai. The elephant is distributed in the Northeastern and Southern States. It is threatened by habitat loss and poaching for ivory. Gaur is found in patches in several well-wooded parts of India.

The best known predator of our forests is the **Tiger**. Its gold and black stripes hide it perfectly in the forest undergrowth. It preys on herbivores such as sambar or chital or less frequently on domestic animals. The tiger kills only three or four times a month. Its numbers have declined due to poaching for its superb skin, and for the supposed magical value of its teeth, claws and whiskers. In the recent past it has been extensively killed for the supposed medicinal properties of its bones that are used in Chinese medicine.

The **wolf, jackal, fox** and the **wild dog** or 'dhole' form a group called canids. Another threatened predator is the Himalayan wolf. The wolves are now highly threatened as they have become increasingly dependent on shepherd's flocks. Thus shepherds constantly find ways to kill the wolves.

CONSERVATION OF BIODIVERSITY: INSITU AND EX-SITU

In-situ conservation

In situ conservation

Biodiversity at all its levels, genetic species and as intact ecosystems, can be best preserved insitu by setting aside an adequate representation of wilderness as 'Protected Areas'. These should consist of a network of National Parks and Wildlife Sanctuaries with each distinctive ecosystem included in the network. Such a network would preserve the total diversity of life of a region.

In the past National Parks and Sanctuaries in India were notified to preserve major wildlife species such as tigers, lions, elephants, and deer.

The objective of these areas should be expanded to the preservation of relatively intact natural ecosystems, where biological diversity – from microscopic unicellular plants and animals, to the giant trees and major mammals – can all be preserved.

Wildlife Sanctuaries and National Parks of India:

There are 589 Protected Areas in India of which 89 are National Parks and 500 are Wildlife Sanctuaries. They include a variety of ecosystems and habitats. Some have been created in order to protect highly endangered species of wild plants and animals found nowhere else in the world.

The Great Himalayan National Park is the largest sanctuary in this ecosystem and is one of the last homes of the beautiful snow leopard. Dachigam Sanctuary is the only place where the rare Hangul or Kashmir stag is found.

There are several Sanctuaries in the Terai region, **Kaziranga National Park** is the most famous which has elephant, wild buffalo, gaur, wild boar, swamp deer, and hog deer, in large numbers, as well as tiger and leopard. Its bird life is extremely rich and includes ducks, geese, pelicans and storks.

The Manas Sanctuary, in addition to the above Terai species, also includes the rare golden langur and the very rare pygmy hog, the smallest wild boar in the world. The florican is found only in a few undisturbed grasslands in the Terai sanctuaries.

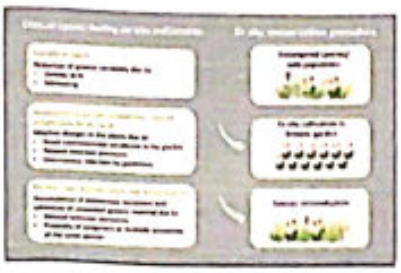
In the sal forests of Madhya Pradesh, there are several Protected Areas. **Kanha** offers a wonderful opportunity to observe wild tigers from elephant back. It is the only Protected Area in which a sub species of the Barasingha is found. Bharatpur is one of the most famous water bird sanctuaries in the world. Thousands of ducks, geese, herons, and other wading birds can be seen here. This is the only home of the very rare Siberian crane which migrates to India every winter. During the last 20 years, the 30 or 40 Siberian cranes have dwindled to only 2 or 3. During 2002-3 no cranes were seen and it is possible that this beautiful bird will never again come to India.

In the Thar desert, the wild life is protected in **The Great and the Little Rann of Kutch** have been made into sanctuaries to protect the very rare wild ass, the flamingo, the star tortoise and the desert fox.

In Gujarat, **the Gir Sanctuary** protects the last population of the majestic Asiatic lion. This thorn and deciduous forest is also the home of large herds of chital, sambhar, and nilgai.

The Sanctuaries of the Western Ghats and associated hill ranges protect some of the most diverse forest types in the country. The few examples of highly threatened species include the Malabar giant squirrel, the flying squirrel and a variety of hill birds, several species of amphibians, reptiles and insects. These regions are also rich in highly endemic plant life. Sanctuaries such as **Bhimashankar, Koyana, Chandoli and Radhanagari** preserve this rich flora in **Maharashtra, Bandipur, Bhadra, Dandeli, Nagarhole, etc**. in Karnataka, and **Eraviculum, Perambiculum, Periyar, Silent Valley,** in Kerala.

Ex-situ conservation



Conservation of a species is best done by protecting its habitat along with all the other species that live in it in nature. This is known as in-situ conservation, which is conserving a species in its own environment by creating National Parks and Wildlife Sanctuaries. However, there are situations in which an endangered species is so close to extinction that unless alternate methods are instituted, the species may be rapidly driven to extinction. This strategy is known as ex-situ conservation, i.e. outside its natural habitat in a carefully controlled situation such as a botanical garden for plants or a zoological park for animals, where there is expertise to multiply the species under artificially managed conditions. These breeding programs for rare plants and animals are however more expensive than managing a Protected Area. There is also another form of preserving a plant by preserving its germ plasm in a gene bank so that it can be used if needed in future. This is even more expensive. When an animal is on the brink of extinction, it must be carefully bred so that inbreeding does not lead to the genetic makeup becoming weak. Breeding from the same stock can lead to poorly adapted progeny or even inability to get enough offspring. Modern breeding programs are done in zoos that provide for all the animal's needs, including enclosures that simulate their wild habitats. There may also be a need to assist breeding artificially. Thus while most zoos are meant to provide visitors with a visual experience of seeing a wild animal close up, and provide the visitors with information about the species, a modern zoo has to go beyond these functions that include breeding of endangered species as a conservation measure.
In India, successful ex situ conservation programs have been done for all our three species of crocodiles. This has been highly successful. Another recent success has been the breeding of the very rare pygmy hog in Gauhati zoo. Delhi zoo has successfully bred the rare Manipur brow antlered deer. However the most important step of a successful breeding program is the reintroduction of a species into its original wild habitat. This requires rehabilitation of the degraded habitat and removal of the other causes such as poaching, disturbance, or other manmade influences that have been the primary cause of reducing the population of the species. Conservation of cultivars and livestock

breeds: There were an estimated thirty thousand varieties of rice grown in India till about 50 years ago. Now only a few of these are still grown. The new varieties which are now being cultivated everywhere have been developed using germ plasm of these original types of rice. If all the traditional varieties vanish completely it will be difficult to develop new disease resistant varieties of rice in the future. Several varieties have been preserved in gene banks. However, this is both very expensive and risky. Encouraging farmers to continue to grow several traditional varieties is thus an important concern for the future of mankind. At present gene bank collections have over 34 thousand cereals and 22 thousand pulses.

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Environmental Studies project/ field hand book

Topic: Sustainability

Session: 2023-2024

Submitted To: Miss P. B. Zamarkar

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Certificate

This is to Certify that the Environmental Studies project/ field hand book written is satisfactorily performed by Mr/Miss Prachya Parsodkar Class T.Y.B.Sc. Section _____ Batch _____ during the academic session 2023-24.

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DECLARATION

I, the undersigned hereby declare that the project/ field hand book entitled Sustainability has been carried out under the guidance and supervision of Dr P. B. Zamarkar, Assistant Professor & Convener and Dr. R. P. Sonwalkar, Assistant Professor & Co convener, SSESA's Science College, Congress Nagar, Nagpur.

This work has been collected from different sources and has not submitted to any other University/ Institution for the award of any degree and diploma.

Place: Nagpur

Date: 1/03/2024

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1. From Unsustainable To Sustainable Development

Until two decades ago the world looked at economic status alone as a measure of human development. Thus countries that were economically well developed and where people were relatively richer were called 'advanced nation while the rest where poverty was widespread and were economically backward were called developing countries. Most countries of North America and Europe which had become economically more advanced. They not only exploited their own natural resources rapidly but also used the natural resources of developing countries to grow even larger economies. Thus the way development progressed, the rich countries got richer while the poor nations got poorer. However, even the developed world has begun to realise that their lives were being seriously affected by the environmental consequences of development based on economic growth alone. This form of development did not add to the quality of life as the environmental conditions had begin to deteriorate.

A growing realization of the development strategy that Mahatma Gandhi has suggested many decades earlier is now accepted by experts on development across the world. This is based on his concept that the world could support people's need but not their greed. It has become obvious that the quality of human life has worsened as economies grew. The world now appears to be at a

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crossroad. It has taken the path of short term economic growth and now suffers the consequences of environmental degradation at the cost of loss of 'quality of human life'. The earth cannot supply the amount of resources used and wasted by the economically well off sectors of society as well as that required for day to day sustenance of the ever growing population in less developed countries. Society must thus change its unsustainable development strategy to a new form where development will not destroy the environment. This form of sustainable development can only be brought about if each individual practices a sustainable lifestyle based on caring for the earth.

Sustainable development is defined as development that meets the needs of the present without compromising the ability of future generation to meet their own need. It also looks at the equity between countries and continents, races and classes, gender and ages.

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Water Conservation, Rainwater Harvesting, Watershed Management

Water Conservation :

As deforestations and desertification spreads due to extensive changes in land use the once perennial rivers are becoming increasingly seasonal. In many areas the small streams run dry soon after the monsoon as the water table drops further and further below the surface. To this is added serious problem caused by rapid surface flow of water during the rains, which leads to extensive floods with loss of the life and property.

When we waste water, we do not realise that it is affecting the lives of all of us in so many different ways. Water has to be equitably and fairly distributed so that household use, agriculture and industry all get a share of the water. It's over use and misuse due to various activites that waste water or cause pollution has led to a serious shortage of potable drinking water. Thus water conservation is linked closely with overall human well being.

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b) Rainwater Harvesting :

Current technologies of rainwater harvesting require that all roof and terrace water passes down into a covered tank where it can be stored for use after the monsoon. This is most advantageous in arid areas where clean water is very scarce. However there are practical difficulties such as constructing large storage tanks which are expensive.

Another way of using rooftop rainwater harvesting is to collect it so that it percolates into the ground to recharge wells instead of flowing over the ground into rivers. Thus by recharging ground water harvesting from rooftops, the water table rises and the surrounding wells retain water throughout the year.

c) Watershed Management :

Watershed management begians by taking control over a degraded site through local participation People must appreciate the need to improve the availability of water both in quantity and quality for their own area. Once this is adequately demonstrated. The community begins to understand the project ; people begin to work

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together in the activities that lead to good watershed management.

The first technical step is to take appropriate soil conservation measures. This is done by constructing a series of long trenches and mounds along contours of the hill to hold the rainwater and allow it to percolate into the ground. This ensures that underground stores of water are fully recharged. This is enhanced by allowing grasses and shrubs to grow and by planting trees (mainly local species) which hold the soil and prevents it from being washed away in the monsoon. Local grass cover can however only increase if free grazing of domestic animals is prevented by stall feeding.

The next measure is to make 'nala' plugs in the streams so that the water is held in the stream and does not rush down the hillside. In selected sites, several small check dams are built which together hold back larger amounts of water. All these measure constitute sound watershed management. It improves the water table and keeps the streams and nalas flowing throughout the year.

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3. Resettlement And Rehabilitation of People :

Its Problems And Concerns.

Major projects such as dams, mines, express ways, or the notification of a National Park disrupts the lives of the people who live there, and may also require moving them to an alternative site. None of us would like to give up the home we grew up in. Uprooting people is a serious issue. It reduces their ability to subsist on their traditional natural resource base, and also creates great psychological pressures. Especially tribal people, whose lives are woven closely around their own natural resources, cannot adapt to a new way of life in a new place. Thus no major project that is likely to displace people can be carried out without the consent of the local people. In India, lakhs of people who have been unfairly displaced by thousands of dams created since independence to drive the green revolution. The dams have been built virtually at the cost of these poor local people who have been powerless to resist the Government's will. The Government is expected to find 'good' arable land to resettle displaced persons and provides them with an adequate rehabilitation package to recover from the disruption.

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Resettlement not only puts pressure on the project affected people but also on the people but also on the people who have been living in the area that has been selected for resettlement. Thus both the communities suffer and conflict over resources is a distinct possibility in future.

CASE STUDY

Indigenous tribes:

It is not flora and fauna alone that is under the threat of extinction. Among the many tribes across the globe, the Jarawa of the Andamans in the Indian Oceans are dwindling. Dispossession of their customary rights over land has put their survival at risk. They have been compelled to give up their traditional lifestyles resulting in rapidly diminishing indigenous population.

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This has rarely occurred to the satisfaction of the project affected individuals. In many cases across the country, this has not been implemented satisfactorily for decades.

Resettlement required alternate land. However, in our overpopulated country, there is no arable high quality land available. Thus most project affected persons are given ~~unusable~~ wasteland. Rehabilitation involves more than just giving land. In most cases this is also not adequately done. The greatest battle to save their own precious land has been carried out by the tribal people of the Narmada River. They have fought to save their lands for decades. The Narmada Bachao Andolan has shown how bitter people can get over this issues.

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4. Equity - Disparity in the Northern and Southern Countries.

Environmental ethics are concerned with, who owns resources and how they are distributed. This can be looked upon at different levels. At the global level it deals with the great-North-South divide between the rich industrialized nations of North America and Europe, as against the needs of developing countries of the south such as in South and Southeast Asia and South America. People living in the economically advanced nations use greater amounts of resources and energy per individual and also waste more resources. This is at the cost of poor people who are resource dependent and live in developing nations.

Changing this unfair economic practice to a more just and fair way in managing trade would require a new thinking on the part of people who live in the super rich countries.

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5. Environmental Ethics :- Issues And Possible Solutions.

Environmental ethics deals with issues related to the rights of individuals justifiably use that are fundamental to life and well being. This concerns not only the needs of each person today, but also those who will come after us. It also deals with the rights of other living creatures that inhabit our earth.

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6. Urban - rural equity issues.

The common property of rural communities has increasingly been used to supply the needs of the urban sector. Land itself that was once held as a common property resource of villages is being taken over by the urban and industrial sectors as it expands. The rural sector not only supplies food, but also a part of the energy needs (mainly fuelwood) to most towns and cities in India, at a pittance. As a result, the common of the rural sector are being depleted of their resources. Thus while the cities get richer the rural sector, especially the landless, get poorer. The urban rich must appreciate where their resources are derived from and be willing to pay a fair price for using them.

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7. The need for Gender Equity

All over India, especially in the rural sector, women work on the whole longer hours than men. The life of women is enmeshed in an inextricable cycle of poverty. In attempting to eke out a living from their environment they must constantly collect fuelwood for their home and for sale to nearby urban areas. They laboriously collect fodder for their cattle. They have to trudge several kilometers to reach a reasonably clean water source. And finally must cook meals in a smoky unhealthy atmosphere on crop waste, every day of the year. There is thus the question of who should control the environmental resources of a rural community. Unfortunately it is the men who play a decisive role in manging the village commons and its resource whereas it should be the local women whose lives are deeply linked with the utilisation and conservation patterns of natural resources, who should be decision makers at the local level. Unfortunately women chave not been given an equal opportunity to develop and better their lot. This begins with the lack of attention given to girls whose education is always given less ateation than the body boys in the family. Unless society begins to see that development cannot be planned by a male dominated

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Society from the male perspective alone, will we be able to create a better living environment for women and their children?

The great divide between women and men is most apparent in communities that live near forests and have by tradition made the women play a greater role than men in collection of natural resources. Women fetch water, collect fuelwood, fruit, medicinal products, etc. day in and day out, while the men work only sporadically in the fields. This disparity in the lives of women and men has also led to a lower access to education and health care for girl children.

This has deep implication for the rate of utilization of natural resources and its conservation. Rural women who are intimately connected to resources, appreciate the value of conserving natural resources more deeply than men. Thus several environmental movements such as chipko have been more strongly supported by local women folk rather than men.

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8. Preserving resources for future generations :

Can we use up all the resources of the world, leaving nothing for our future generations ? This ethical issue must be considered when we use resources unsustainably. If we overuse and misuse resources and energy from fossil fuels, our future generations would find survival much more difficult. A critical concern is to preserve species and natural undisturbed, which must be protected for the use of future generation. Our generation does not own the worlds resources to do whatever we please with them. Just as our ancestors have left resources for us, it is our duty to leave them behind for our future generations. These unborn people have a right to these resources. We only hold the world as trustees so that future generation can also survive.

Our current development strategies have led to environmental resources being overused and misused by our present generation without a thought for the needs of future unborn generation. We need of future unborn unborn generation. We need to appreciate that the next generation and those that will come later also have a right to the earths natural resources.

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9. The ethical basis of environment education and awareness:

Perhaps the most important concern is related to creating an ethos that will support a sustainable lifestyle in society. This brings us to the need for environmental education. The Honorary Supreme Court of our country has thus ordered that every young individual at school and colege level be exposed to a course on environment. It is not to create only an awareness of environment issues, but also to bring about pro environment issue action. Among the vesiety of tools that can bring home the ethical issues of the environment; no solution is as powerful as real life experiences in nature. Creating a love for nature brings about strong pro environmental action. Our current educational processes at school and college level are being reoriented to bring this about.

There are two aspects that are closly connected with ethical issues that are related to our environment. These are based on valuing nature and appreciating the beauty of nature and treasuring the magnificence of the wilderness.

Many species were not only valued, but also venerated.

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Education in nature - The Shantiniketan model

Rabindranath Tagore founded shantiniketan and taught an environment-based philosophy. Tagore's philosophy of education focused attention on the need for a harmonious association between human beings and their environment. To achieve this he relied on exposing young people on nature. This went back to our roots where in ancient India, learning centers were established remote forests. Tagore linked these concepts with celebration of nature through music, dramas, dance and poetry.

At Shantiniketan, there were celebrations for each season and ceremonial tree planting. He started Vriksha ropan way back in 1928. In fact much of that was initiated as the route to environment education and sustainable living and is essentially based on preserving nature.

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10. The Conservation ethic and traditional value systems of India.

In ancient Indian traditions people have always valued mountains, rivers, forests, trees and several animals. Thus much of nature was venerated and protected. Forests have been associated with the names of forest gods and goddesses both in the Hindu religion as well as in tribal cultures. 'Tree' goddesses have been associated with specific plant species Ficus religiosa, the peepal tree, is venerated and is thus not to be cut down. The Banyan tree in some regions such as Maharashtra, is venerated once a year by tying a thread around is as a symbol of respect. The tulsi plant is grown on the doorstep outside every home.

Patches of forest have been dedicated to a deity in many Indian cultures especially in tribal areas. These traditionally protected forest patches depict the true nature of undisturbed vegetation and have a large number of indigenous plant species as their exploitations has been controlled through local sentiments.

Certain species of trees have been protected as they are valued for their fruit or flowers. The mango tree is protected for its fruit around most farms even when wood becomes scarce. The mohua tree.

(Madhuca indica) is protected by tribal people as it provides edible flowers, oil from its seeds and is used to make a potent alcohol. Many plants, shrubs and herbs have been used in Indian medicines which were once available in the wild in plenty. They are now rapidly vanishing. Many species of animals are venerated as being the 'vahan' or vehicle of different gods on which they are said to travel through the cosmos.

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"EXCURSION Field REPORT"

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CERTIFICATE

This is certify to the "**FIELD STUDY REPORT OF PARSHIVNI, RAMTEK AREA** "*submitted to department of* geology **SHRI. SHIVAJI SCIENCE, COLLEGE, NAGPUR,** embodies literature files work carry out by BSC 2ND YEAR 4TH sem student.

They have taken proper care and shows have most sincerity in completion of this tour report. This report genuine and does not indulge in plagiarism of any kind.

Date: 18.03.2024

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DECLARATION

We Sumati S. Kale, Himanshi Mehar, Saloni Nandanwar and Aarti Baghel, students (Semester IV), Department of Geology, S.S.E.S.A's Science College, Congress Nagar, Nagpur do hereby declare that "Geological Field Excursion to Parseoni & Ramtek Area" undertaken under the supervision of Mr. Rashtrapal Chavhan (Director, GSIFTC, Nagpur) and Dr. Chatrapal Ramteke (Geoscientist from GSIFTC, Nagpur) and Faculty members Mr. Mahesh Phalke, Dr. Pushpa Zamarkar and Ms. Apurva Fuladi, is an original work done by me. This report has not been submitted to any institute for the award of any degree.

Date: 18-03-2024

Student's Signature

1] Sumati Sanjay Kale Skale

2] Himanshi Vijay Mehar Hmel

3] Saloni Arun Nandanwar Saloni

4] Aarti OMshakar Baghel Aarti

Submitted by:

Sr.no.	Name of Students	Signature
1	Sumati Sanjay Kale	
2	HIMANSHI VIJAY MEHAR	
3	Saloni Arun Nandanwar	
4	Aarti Omshakar Baghel	

Guided by:

Mr. Mahesh Phalke Sir

Mrs. Pushpa Zamarkar Mam

Ms. Apurva Fuladi Mam

ACKNOWLEDGEMENT

We would like to express to deep since gratitude to the Principal **Dr. O. S. Deshmukh Sir Shivaji Science College Nagpur and Mr. Mahesh Phalke Sir** for the permission and kind help for this tour. Special thanks to our teachers **Mrs. Pushpa Zamarkar** and Ms. Apurva Fuladi and Mr. Rashtrapal Chavhan (Director, GSIFTC, Nagpur) and Dr. Chatrapal Ramteke (Geoscientist from GSIFTC, Nagpur) who gave us the golden opportunity to carry out the visit in **Parseoni & Ramtek Area** which help us if doing lot study and we came to know about so many new, facts eventually leading to improving our knowledge and report writing this assignment helped us in understanding the physical properties and occurrences of various minerals. We are also thankful to our teachers and friends for emboldening and helped us to finalizing this tour repot within the limited frame of time.

DATE: 18/03/2024.
Place: Nagpur

Students of Quartz Group
BSC II Year (Semester-IV)
S.S.E.S.A's Science College,
Congress Nagar, Nagpur


SHRI
1/9
SCIENCE COLLEGE
Congress Nagar, Nagpur
GEOLOGICAL
FIELD EXCURSION

INDEX

1 Introduction

1. Purpose of field work

- Geological fieldwork helps exploration it's generate new ideas. It provides a setting for discussion and allows the application of new concepts. The rocks don't change; what changes is the way we view them. In the field, observations can be discussed and new doors opened to collaboration.

2. Aims and Objectives

- The aim behind organizing a field excursion is to give a proper exposure to the student in the field of geology and to get idea about the nature and mineral deposits of the area under study and to locate and position in the map.

3. Objectives of geological field excursion

- To get well a quainter with the field directly.
- To study and map different structure on different scales.
- To get a details about geology of the area.
- To predict the past geological history and environment on the basis of lithology, structure and other important things.
- To know the economic importance of particular by studying minerals.

4. About the study area

Kanhadevi is a small Village hamlet in Parshvini Taluka in Nagpur District of Maharashtra State, India. It comes under Kanhadevi Panchayath. It belongs to Vidarbh region. It belongs to Nagpur Division. It is located 38KM towards North from

District headquarters Nagpur.11 (km) from State capital Mumbai.

Kanhadevi Pin code is 441101 and postal head office is Kappa. Kothulna (6KM), Kirnapur (8KM), Amgaon (KM), Amgon, Bitoli (9KM) are the nearby Villages to Kanhadevi. Kanhadevi is surrounded by Saoner Taluka towards west Ramtek Taluka towards east Kalmeshwar Taluka towards west.

5. Accessibility:

The visit was made on 6th March 2024. The luxury bus was made to reach the study area from Nagpur city. The distance is about. We gathered in the morning at about 8:30 am in the college premises the bus left for the Nagpur at about 7p.m. in the evening.

6 General Geographical Area:

It is situated 18km away from sub-district headquarter Parshivni (Tehsildar office) and 53km away from district headquarter Nagpur. As per 2009 stats, Tekadi is the gram Panchayat of Kanhadevi village.

The total geographical area of village is 213.45 hectares.

According to Census 2011 information the location code or village code of Kanhadevi village is 535372. Kanhadevi village is located in Parshivni tensile of Nagpur district in Maharashtra, India.

It is situated 18km away from sub-district headquarter Parshivni (Tehsildar office) and 53km away from district headquarter Nagpur. As per 2009 stats, Tekadi is the gram Panchayat of Kanhadevi village.

His total geographical area of village is 213.45 hectares Kanhadevi has a total population of 272 peoples, out of male population is 124 while female population is 48.

1. Equipment's:

Geologist's Hammer

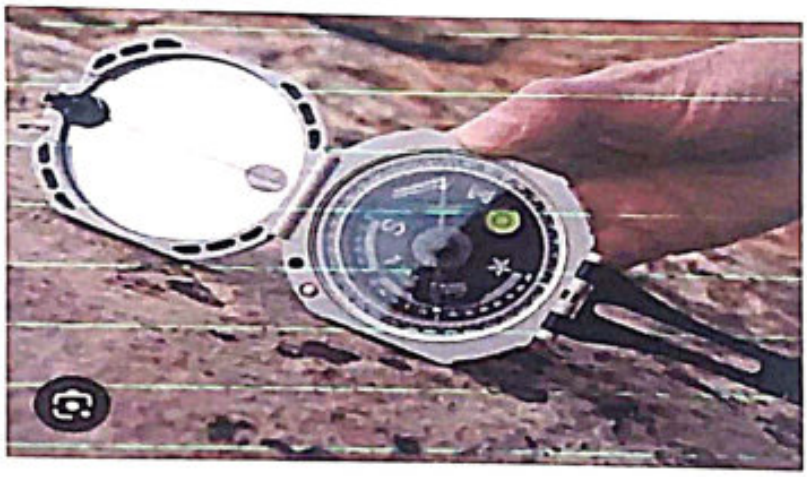
A **geologist's hammer, rock hammer, rock pick, geological pick**, or informally is a hammer used for splitting and breaking rocks. In field geology, they are used to obtain a fresh surface of a rock to determine its composition, bedding orientation, nature, mineralogy, history, and field estimate of rock strength. In fossil and mineral collecting, they are employed to break rocks with the aim of revealing specimens inside. Geologist's hammers are also sometimes used for scale in a photograph. The hammer also serves as an extension of the senses, permsitting the geologist to perceive the rock's granularity, soundness, and resistance to fracturing that may be relevant to its use.

Geologist's Hammer

2. Brunton Compass

The Brunton compass, while over 100 years old, is still the primary tool for generating geologic field data. There are several key components of the compass, including the sighting arm, magnetic needle, clinometers, index pin, and bubble and clinometers levels.

It is used to directional degree measurements (azimuth) through use of the Earth's magnetic field. Holding the compass at waist-height, the user looks down into the mirror and lines up the target, needle, and guide line that is on the mirror.



Brunton Compass

3. Topographic Map

A topographic map refers to a detailed, graphical, and accurate representation of features that appear on the Earth's surface.

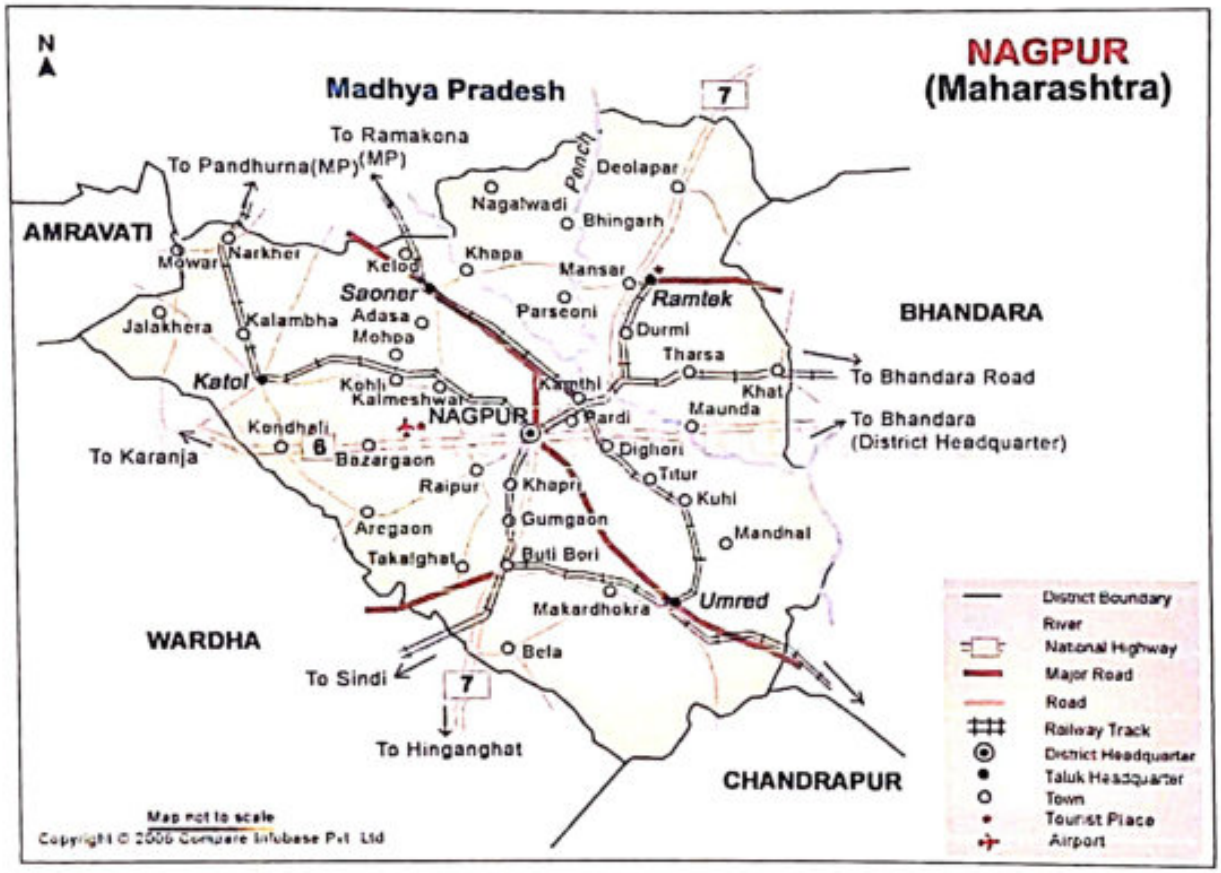
Topographic maps are an essential part of the field of geology due to the comprehensive analysis of a particular surface. Students can explore more about the topographic map here. A topographic map is a map that represents the locations of geographical features. Furthermore, these geographical features can be mountains, valleys, plain surfaces, water bodies and many more.

Topographic maps refer to maps at large and medium scales that incorporate a massive variety of information. All the components of topographic maps carryequal importance.

Topographic maps refer to a graphical representation of the threedimensional configuration of the surface of the Earth. Moreover, such maps show the size, shape, and distribution of landscape feactures.Also, such maps present the vertical and horizontal positions of those features whose representations take place. Most noteworthy makes use of contour lines so as to show different elevations on a maps.

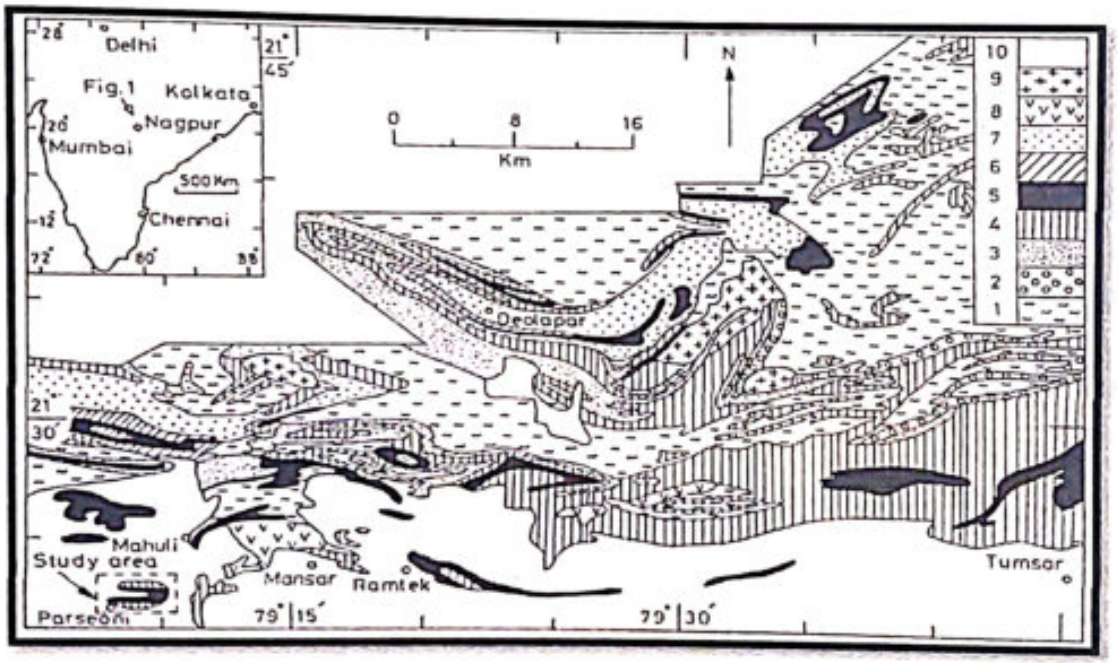
L1: Study of topographic Map

Topographic Map of Parshvini: Precambrian metasediments of Parshivni area belong to the Sausar Group. These comprise of quartzite, mica schist with manganese ore and marble. The metasediments of the area show evidence of three phases of folding. The early folds (F1) are isoclinal with an axial planar cleavage (S1). The second folds (F2) are tight to isoclinal with axial planar crenulation cleavage (S2). These F2 folds have EW striking vertical axial planes and congruous pucker axis lineation. The third folds (F3) are open upright with NS striking axial planes. An antiformal F2 fold plunging E is mapped in the area. In the absence of any primary top-and-bottom criteria the stratigraphic succession for the area suggested by earlier workers is debatable.



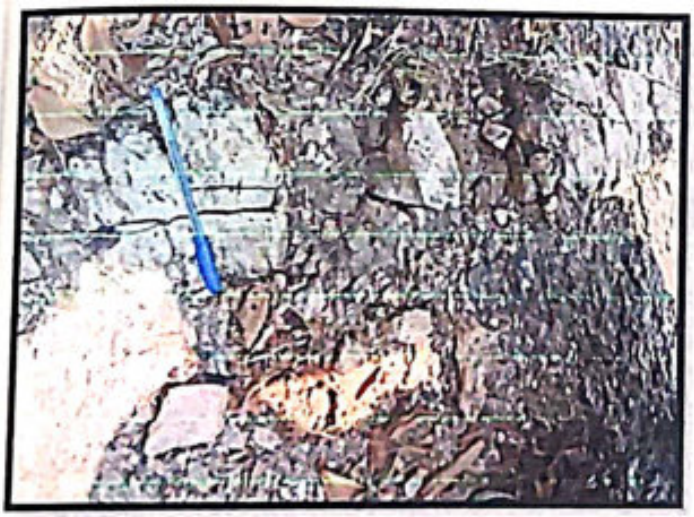
L2.Saucer Fold Belt:

Precambrian metasediments of Parshivni area belong to the Sausar Group. These comprise of quartzite, mica schist with manganese ore and marble. The metasediments of the area show evidence of three phases of folding. The early folds (F1) are isoclinal with an axial planar cleavage (S1). The second folds (F2) are tight to isoclinal with axial planar crenulation cleavage (S2). These F2 folds have EW striking vertical axial planes and congruous pucker axis lineation. The third folds (F3) are open upright with NS striking axial planes. An antiformal F2 fold plunging E is mapped in the area. In the absence of any primary top-and-bottom criteria the Stereographic the area suggested by earlier workers is debatable.

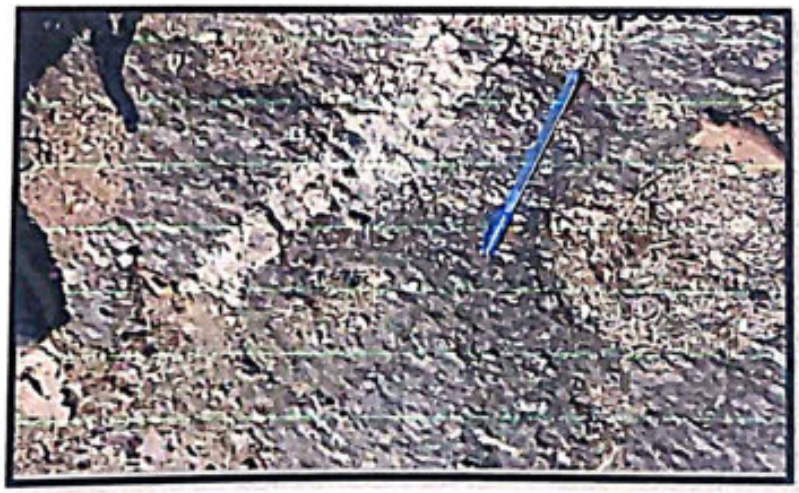


L3: Quartz Feldspar Tourmaline Veins

Pegmatite and alkali feldspar granite emplaced in the basement Triode biotite Gneisses and Saucer Group of rocks in Saucer mobile belt of Central Indian Tectonic Zone (CITZ) around Parshivni, Nagpur district. Pegmatite occurs as parallel sills, dykes and veins showing sharp contact with host TBG and rocks of Saucer Group. In petrography, pegmatites are essentially composed of quartz, plagioclase, k-feldspar (microcline), muscovite, biotite, tourmaline and garnet.



QUARTZ FELDSPAR AND TOURMALINE



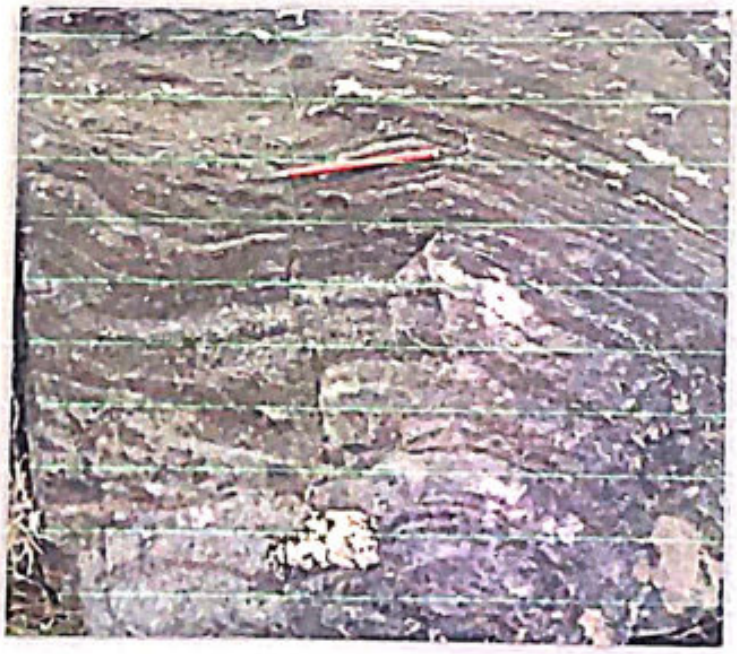
L4: Mica Schist's Outcrop

Mica schist is a metamorphic rock that formed through the intense heat and pressure that were generated when Africa and North America slammed together to create Pangaea, about 275 million years ago. Foliation is a rock characteristic that looks like fine layering in the rock. These layers form during metamorphism and often make the rock look like it might break into thin sheets. The foliation forms due to minerals being squished and flattened by the intense pressure that exists during metamorphism and by flat minerals (like micas) being rotated to line up perpendicular to the pressure. The presence of foliation will tell a geologist that this rock experienced the intense heats and pressures required to cause the minerals to squish and rotate in this way. The only natural forces known that can cause foliation like this are continental collisions.

MICA SCHIST OUTCROP

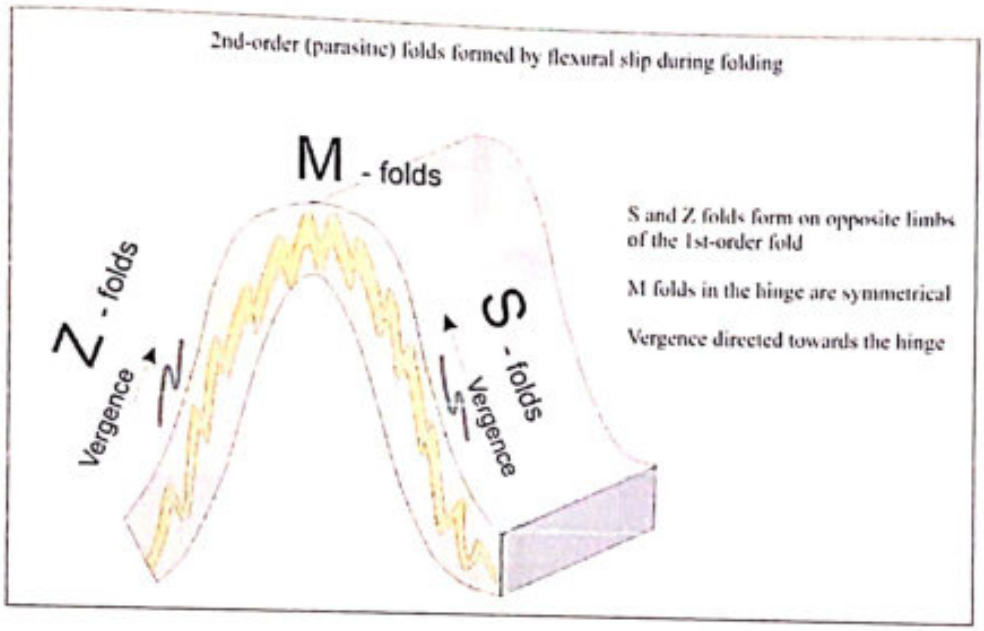
L5: Mansar

- The Mansar rock found in the Mansar area of Maharashtra, India are part of the Sausar group and the Tirodi Gneiss:-
- **Mansard formation**: this formations rich in mica schist, muscovite –biotite -schist with sillimanite, and intercalations of manganese ore horizon with gondites rocks.
- **Charbroil Formation:** This formation is made up of quartzite, quartz-schist, and quartz muscovite schist with sillimanite bearing tabloids.
- The Sausar Group rocks are precambrian in age and show signs of polyphase deformation. The basement for the Sausar group is the Tirodi biotitic gneiss.



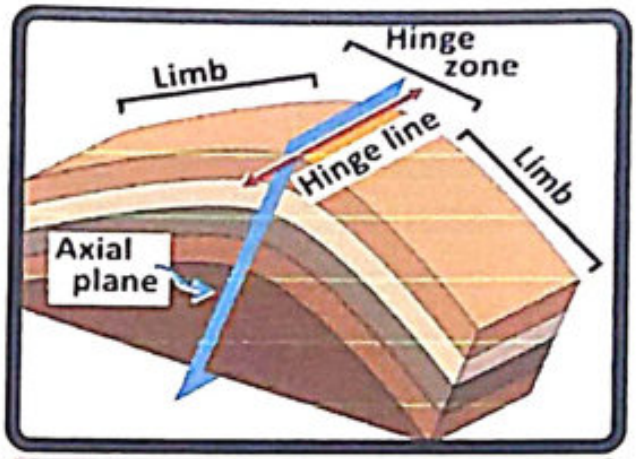
L6: Z type Fold

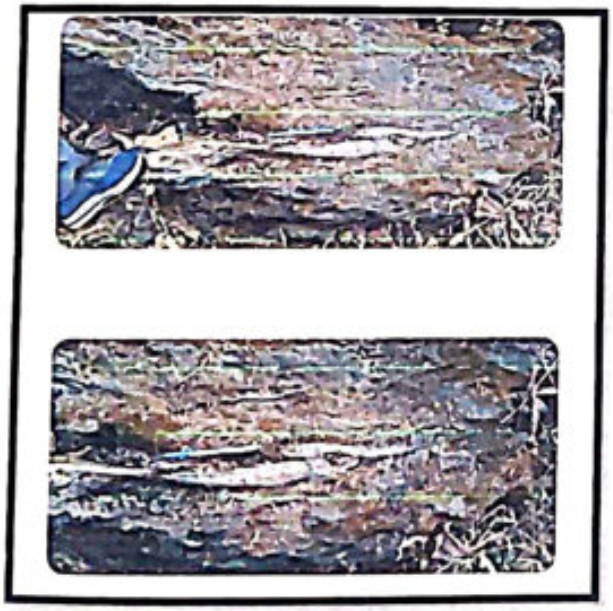
Z-folds have short limbs that appear to have been rotated clockwise with respect to their long limbs. Z-folds thus mimic the letter Z when considering the short limb and its two adjacent long limbs. The difference between S- and Z-folds lies in their sense of rotation, or **mergence**. The long limbs of S-folds are connected by a shorter limb that implies counter-clockwise rotation or sense of displacement; the opposite applies to Z-folds. Thus, the vengeance of parasitic folds is **towards the hinge line** (or zone).



Z-folds are three dimensional structures and will have hinge lines (or fold axes if we consider them to be cylindrical folds) and axial surfaces that can be measured. Another important property of parasitic folds is that their hinge lines (or fold axes) are parallel (or approximately so) to the hinge line of the 1storder fold.

A note of caution; the sense of fold rotation-displacement will change if a fold is viewed from the opposite direction (i.e. Sfolds will appear as Z-folds). Hence it is necessary to indicate the direction in which observations are made. Where possible, folds should be viewed down-plunge.





Z type fold

The geometric disposition of Z-folds is extremely useful for deciphering large-scale folds, particularly when exposure is incomplete (as is commonly the case). The diagram below shows a scenario, where small folds are exposed in two outcrop

L7: Magnetite and Carbonate Rock

Basin ending towards north and supply through south.

Carbonate is a type of intrusive or extrusive igneous rock defined by mineralogical composition consisting of greater than 50% carbonate minerals Carbonate may be confused with marble and may require geochemical verification.

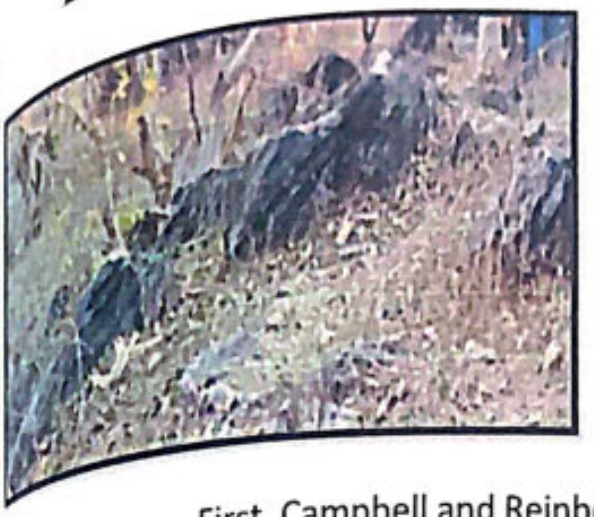
Carbonates usually occur as small plugs within zoned alkali intrusive complexes, or as dikes, sills, breccia's, and veins. They are almost exclusively associated with continental rift-related tectonic settings. It seems that there has been a steady increase in the carbonate igneous activity through the Earth's history, from the Achaean eon to the present.

Nearly all carbonate occurrences are intrusive or sub volcanic intrusive. This is because carbonate is therefore unlikely to be preserved in the geologic record. Carbonate eruptions as lava may therefore not be as uncommon as thought, but they have been poorly preserved throughout the Earth's history.

Carbonate liquid compositions are significantly more alkaline than what is preserved in the fossil carbonate rock record as composition of the melt inclusions shows

Magnetite and Carbonate rocks

LS: Bedding



In geology, a **bed** is a layer of sediment, sedimentary rock, or volcanic rock "bounded above and below by more or less well-defined bedding surfaces". Specifically in sedimentology, a bed can be defined in one of two major ways.

First, Campbell and Reinbeck and Singh use the term *bed* to refer to a thickness-independent layer comprising a coherent layer of sedimentary rock, sediment, or pyroclastic material bounded above and below by surfaces known as **bedding planes.** By this definition of bed, lamina are *small beds* that constitute the smallest (visible) layers of a hierarchical succession and often, but not always, internally comprise a bed.

In geology, a **bedding surface** is a planar, nearly planar, too wavy or curved 3-dimensional surface that visibly separates each successive bed (of the same or different lithology) from the preceding or following bed. Where bedding surfaces occur as cross-sections, e.g., in a 2-dimensional vertical cliff face of horizontal strata, are often referred to as *bedding contacts*. Within conformable successions, each bedding surface.

L11: Boudinage

Boudinage is a geological term for structures formed by extension, where a rigid tabular body such as hornfless, is stretched and deformed amidst less competent surroundings.

The competent bed begins to break up, forming sausage-shaped bounding. Boudinage is common and can occur at any scale, from microscopic to lithospheric, and can be found in all terranes.

In lithospheric-scale tectonics, boudinage of strong layers can signify large-scale creep transfer of rock matter. The study of boudinage can also help provide insight into the forces involved in tectonic deformation of rocks and their strength.

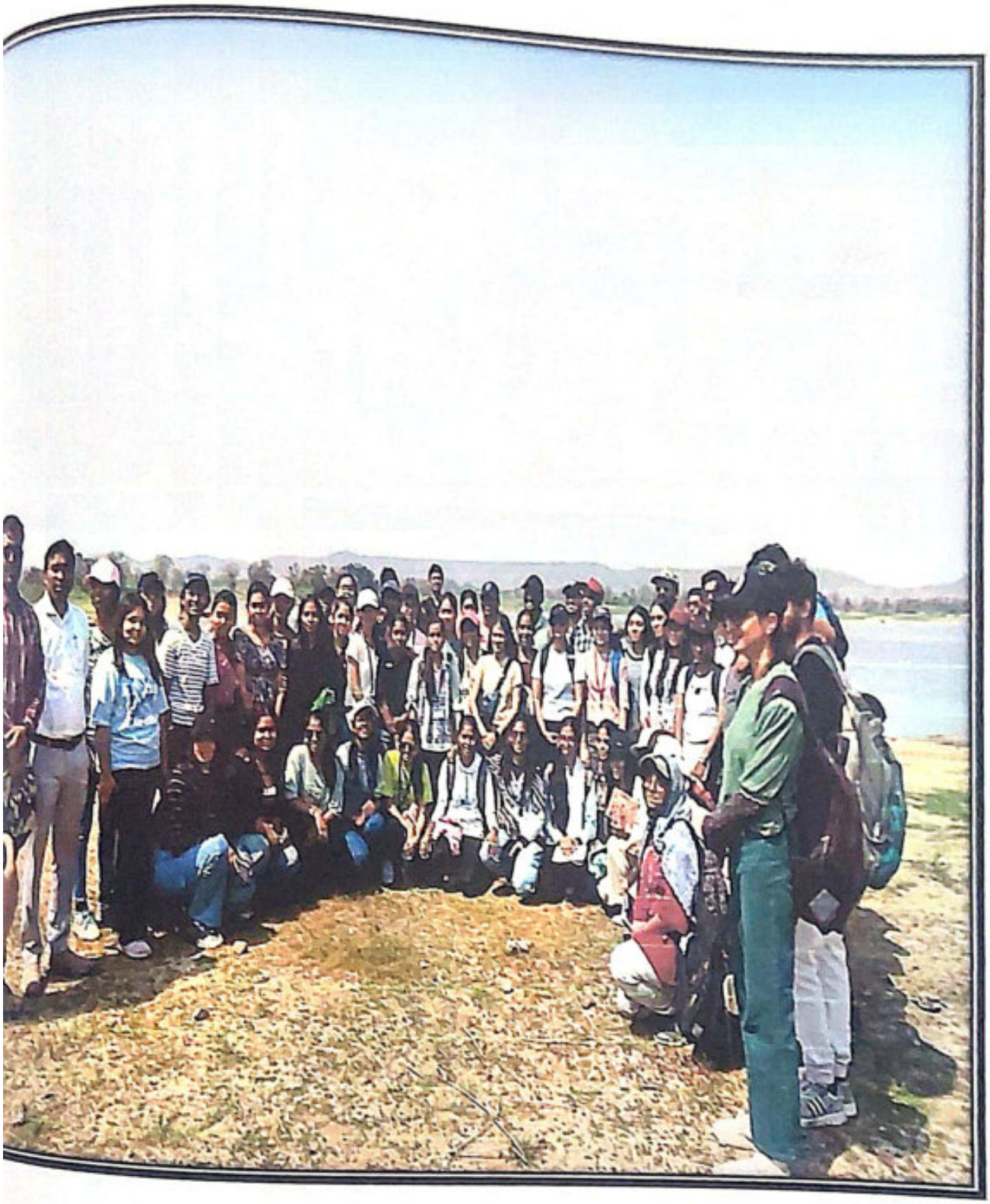
SUMMARY

Importance of geology in various field briefly described. Once heard thing may once. At we observed various types of rocks such as micas schist's, literate, quartzite and also,

We learnt about various characteristics of this rock which was beneficial for us as it forms a part of our sybullus.

The trip to Parshivni also gave us and ideas of conducting field work and the various aspects of field work such as sampling of the rock, drawing geological field diagrams etc.

The saucer group of palaeoproterozoic age comprises a thick sequence of carbonate quartzite psammopelitic rocks. These rock have undergone polyphase deformation. The regional E-W to ENE-WSW alignment .



IQAC Coordinator
S.S.E.S.A's
Science College, Nagpur

Science College, Congress Nagar Nagpur SEAL

Principal
S.S.E.S. Amravati's
Science College, Nagpur

LTID.

SHRI SHIVAJI EDUCATIONAL SOCIETY
AMRAVATI'S
SCIENCE COLLEGE
CONGRESS NAGAR, NAGPUR, Maharashtra-440012

Field Tour Report

Submitted To: Mr. Mahesh Phalke
Head-Department of Geology

Guided by: - 1. Dr. Pushpa Zamarkar
2. Ms. Apurva Fuladi

Submitted by: - Sayali Chandrapal Kamble

CERTIFICATE

This is to certify that "**FIELD REPORT OF PARSEONI**" submitted to Department of Geology, SHRI SHIVAJI SCIENCE COLLEGE, Nagpur, Embodies the result of literature field.

Work carried out by "**Sayali Kamble**" B.Sc. final year, fifth semester.

They have taken proper care and have shown at most sincerity in the completion of this Tour report. This tour report is genuine and does not indulge in plagiarism of any kind.

Date- 18-03-2024

Teacher In-Charge

Signature of HOD

HEAD
Department of Geology
S. S. E. S. Amravati's
Science College, Nagpur.

IQAC Coordinator
S.S.E.S.A's
Science College, Nagpur

SEAL

Principal
S.S.E.S. Amravati's
Science College, Nagpur

DECLARATION

I Sayali Kamble, student of the Department of Geology, Shivaji Science College, Congress Nagar, Nagpur, semester V, Do hereby declare that the study tour report on 'Parseoni', undertaken under the supervision of Dr. Pushpa Zamarkar and Ms. Apurva Fuladi, is an original work done by me. This report has not been submitted for the award of any diploma or degree.

Student's Signature

Signature: 
Name: Sayali Kamble

Date: 18-03-2024

ACKNOWLEDGEMENT

At the very on set, we would express our profound thanks to Mr. Mahesh Phalke sir, Head of Department of Geology for organizing this field trip and giving us the opportunity to conduct field work and his constant guidance throughout the field work.

We would also like to thank and express our gratitude to Dr. Pushpa Zamarkar madam and Ms. Apurva Fuladi madam for guiding us, supporting us and providing us useful information during the field trip.

We would also like to thank the staff members for providing us with necessary help during the trip.

At last, we would like to thanks everyone who directly or indirectly helped us during the course of the field trip.

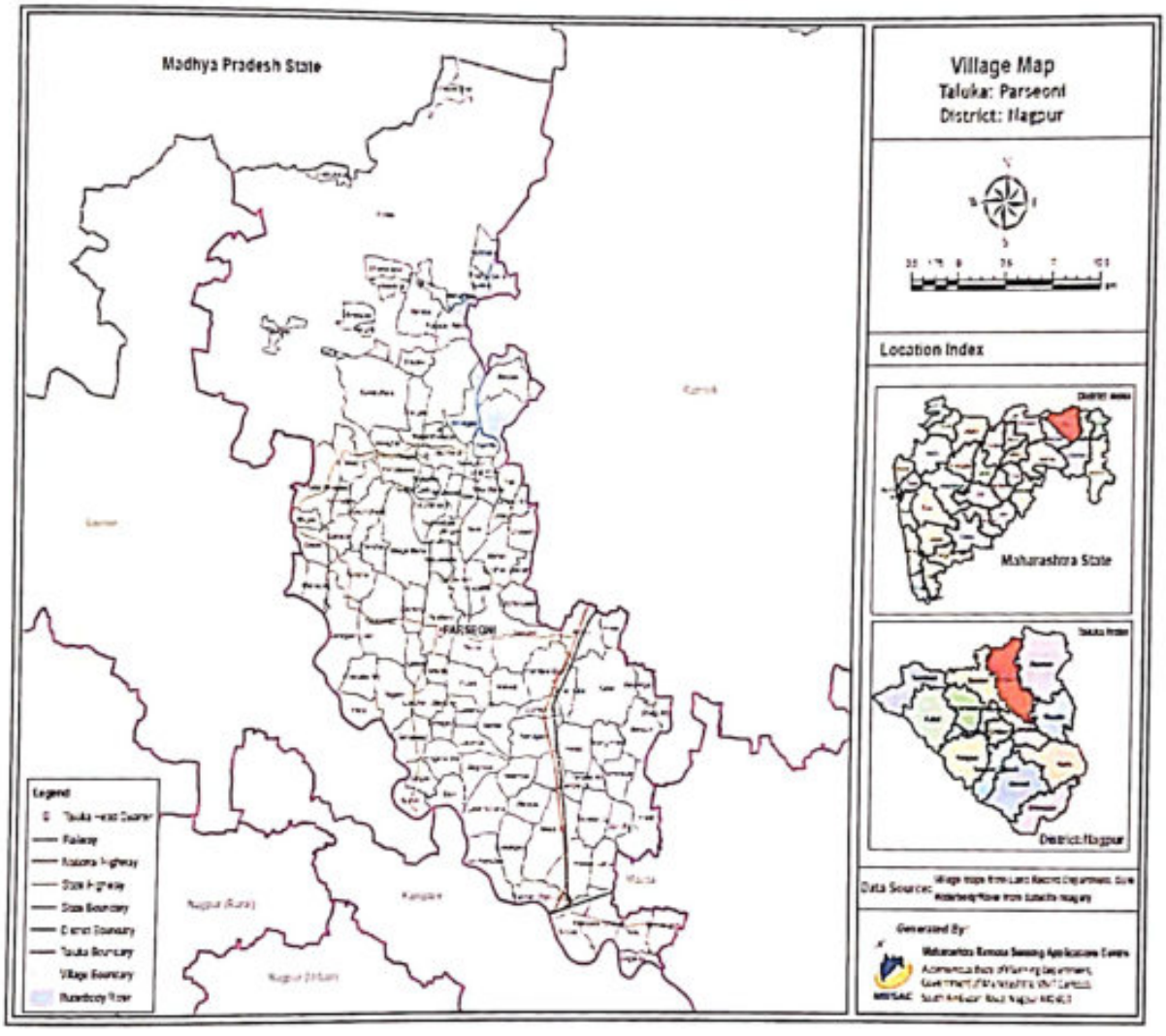
INDEX

INTRODUCTION

Parseoni is town Ramtek sub-division of Nagpur district and Nagpur revenue Division in the Berar region in the state of Maharashtra, India. It is located on the banks of Pench River.

Parseoni is a fine confluence of devotion, literature and history. It is a popular and important tourist center as the tiger sanctuary nearby, places of worship and having a lot significance of geological history.

The region which is around 57 kilometers from Nagpur, it belongs to Nagpur division. It is located 35 km towards North from district head-Quarter Nagpur. The Precambrian meta sediments of Parseoni are belong to the Sausar Group. These comprise of quartzite, mica schist with manganese ore and marble. Braunite (manganese ore) is found in the Mansar formation belonging to the Sausar group found in Parseoni.



Map of Parsheoni

PURPOSE OF THE TOUR

Tour or Excursion is a journey by a group of people to a place away from them to nature environment. The purpose of this tour is usually observation for educational research or to provide students with experience outside their everyday activities. Geological field trips provide several advantages for students.

Firstly, field trips allow students to engage in hands-on learning experiences, which are considered fundamental and effective in teaching the natural sciences. By being in the field, students can have the opportunity to observe and investigate real geological phenomena, rather than relying solely on textbook examples.

Additionally, field trips help students develop important skills such as critical thinking, problem- solving, and data collection and analysis. Field trips also contribute to a deeper understanding of geological concepts and processes, as student scan directly apply their knowledge in real-world settings.

Furthermore, field trips promote inclusivity and accessibility in geoscience education, as virtual tools and universal design principles can be incorporated to accommodate students with disabilities or other barriers to traditional field work. Overall, geological field trips offer unique learning opportunities and foster a deeper appreciation and understanding of the Earth's geology

ACCESSIBILITY

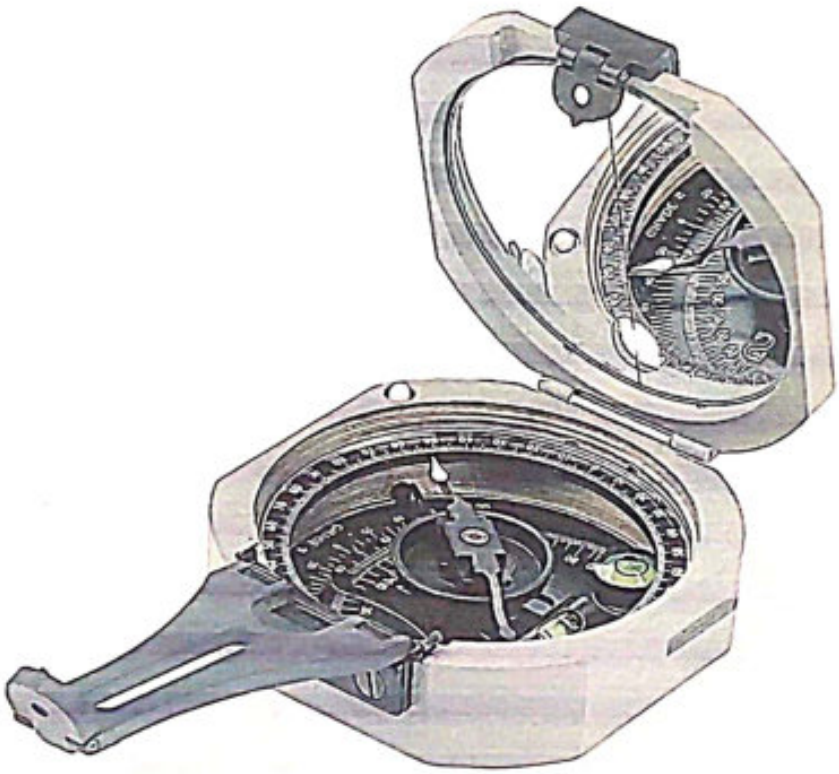
Our tour started on the morning of 6th March. We all gathered at our college premises at 8.00 am and departed for Parseoni at 8.15 am by bus. It was a 34.80 km journey. We reached there at 11.30am and then our teachers briefed us about the various procedures and guidelines to follow for the field work and they also provided us with the tools we would be requiring for the survey. shortly after which we were on our way marching towards our first spot. There sir told us about the basics of toposheets, topography of the area, hills, rock types etc. From Parseoni, we went to Salai for seeing another formation from the same stratigraphic group. We saw all the formations of the Sausar group. At 4.00 pm we went to Ghogra Mahadev Temple. We had lunch there after which we enjoyed playing in the river.We were therefore couple of hours and then we departed for Nagpur at 6.00 pm and by 8.00 pm we reached Nagpur.

METHODOLOGY

Brunton Compass

A compact pocket instrument that consists of an ordinary compass, folding, open sights, a mirror and a rectangular spit- level clinometer which can be used in the hand or on a staff or light rod for reading horizontal and vertical angles for leveling and for reading the magnetic bearing of a line. It is used in sketching mine workings, and in preliminary topographic and geologic surveys on the surface.

Ex; in determining elevations, stratigraphic thickness and strike an dip.



GEOLOGICAL HAMMER

A geologist's hammer, rock hammer, rock pick or geological pick is a hammer used for splitting and breaking rocks. In field geology, they are used to obtained a fresh surface of a rock to determine its composition, bedding orientation, nature mineralogy, history and field estimate of rock strength. In fossils and mineral collecting they are employed to break rocks with the aim of revealing fossils inside. Geologist's hammers are also sometimes used for scale in photograph.

The hammer also serves as an extension of the senses, permitting the geologist to perceive the rock's granularity, soundness and resistance to fracturing that may be relevant to its use or identification.

GEOLOGY OF THE AREA

Precambrian metasediments of Sausar Group crop out in an arcuate belt north of Nagpur. These metasediments bear imprints of atleast three generations of superposed folding. The regional EW extension of the belt is parallel to the axial traces of the second-generation folds. The arcuate nature of the belt (NNW-SSE in the western part and NNE-SSW in the eastern part) has resulted from the overprinting of upright folds of third generation with NS striking axial planes. Detailed mapping correlates the variations in structural geometry and to understand the tectonics of the belt. Structural evolution of an area around Parseoni, Nagpur District, Maharashtra, corroborates the structural history deciphered from other areas.

In this area, the effects of the folds of third generation in modifying the orientation of the earlier structures are established on map scale. Additionally, the stratigraphic success is of the studied area has been a matter of debate.

Therefore, the structural pattern of the area is discussed here to critically analyze the stratigraphic problem, and to understand the litho-structural controls of the manganese ore body exposed in the area.

GEOLOGICAL SETTING

The Parseoni manganese ore-body was explored by the Geological Survey of India during 1972-1976. Several lenticular bodies of one to seven metres width, each extending for a maximum length of 400 metres, were reported from the area. The major structure of the area was confirmed to be an anti-form plunging towards east, with an inverted stratigraphic sequence of Chorbaoli, Mansar and Lohangi Formations. The mineral assemblage of rhodochrosite, pyroxmangite, magnetite, garnet, Mn cummingtonite, pyrophanite, quartz and tephroite from conformable lenses of manganese-rich rocks in mica schist of Parseoni area.

The assemblage was interpreted to be the product of metamorphism of a rhodochrositemagnetite-

quartzprotolithinalowC02condition by the following reaction: -

1. Rhodochrosite+magnetite+quartz=Tephroite+magnetite+CO2

2. Rhodochrosite+magnetite+quartz-Pyroxmangite+magnetite+CO2

3. Tephroite+magnetite+quartz=Pyroxmangite+magnetite.

ROCK TYPES

The three metasedimentary rocks mapped in Parseoni area are quartzite, mica schist and marble. The marble is exposed in the northern part of the area. The quartzite and its lithofacies equivalent unit (micaceous quartzite and conglomerate) are exposed along a low ridge passing through the township of Parseoni and forming a horse-shoe shaped pattern to the east of the township. The mica schist (phyllite, sericite schist, muscovite-biotite schist and feldspathic schist with manganese ore is exposed along the outer fringe of the arcuate ridge of quartzite. These rocks contain sericite, muscovite, biotite, chlorite, microcline, plagioclase, sillimanite, garnet, rhodonite, tephroite and opaque minerals.

The manganiferous rock mainly contains braunite, jacobsite and bixbyite as ore minerals.

Minor amounts of rhodochrosite are also present. Aggregates of quartz are elongate with long axis parallel to the schistosity. These grains show undulose extinction and subgrain development.

The aspect ratio of these aggregates varies from 10to35. Muscovite and biotite aggregates are also parallel to the schistosity. Some of the mica grains show post- crystalline kink folding. Garnet porphyroblasts show pressure shadow parallel to the schistosity (S1) and rotational Sitrails, indicating their syntectonic crystallisation with respect to the F1 deformation.

GEOMORPHOLOGY

SPOT1-TOPOGRAPHIC MAP

Topographic maps are detailed representations of a landscape's surface features, showing the contour lines that delineate changes in elevation. These maps are essential tools for various purposes, from outdoor recreation tour ban planning and scientific research.

Here are some points to consider regarding topographic maps:

1. Elevation Information: Topographic maps provide precise information about the elevation of the land surface. This information is crucial for understanding the terrain's shape, steepness, and overall relief.

2. Contour Lines: Contour lines are the primary feature of topographic maps. They connect points of equal elevation, allowing users to visualize the shape of the land and its features such as hills, valleys, ridges, and depressions.

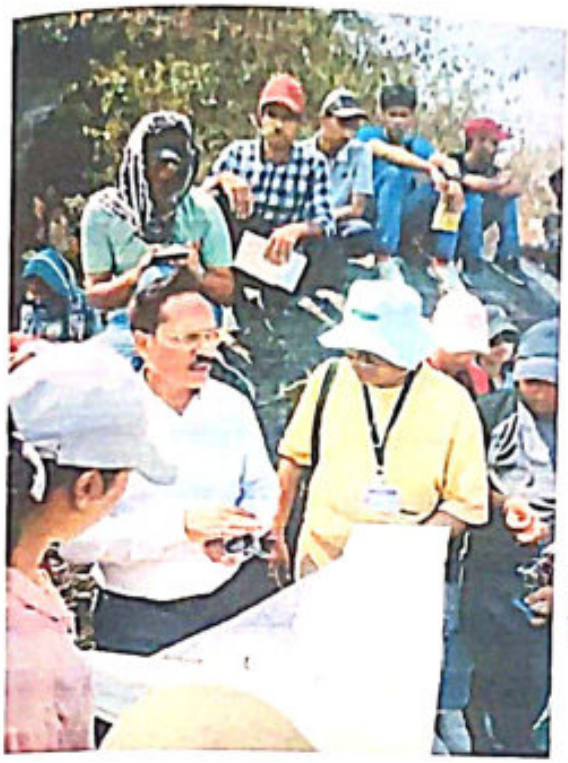
3. Scale: Topographic maps have a scale that indicates

the relationship between distances on the map and actual distances on-the-go runs. This allows users to measure distances accurately and plan routes.

4. Symbols and Legends: Topographical sues symbols and legends to represent sent various features such as rivers, roads, trails, buildings, vegetation, and cultural landmarks. Understanding these symbols is essential for interpreting the map accurately.

5. Gradient and Slope: By closely examining contour lines, users can determine the steepness of slopes and gradients. This information is valuable for activities like hiking, skiing, engineering projects, and land use planning

6. Applications: Topographic maps are used inawide range of applications, including outdoor recreation (hiking, camping, hunting), urban planning, natural resource management, environmental assessment, geological exploration, and military operations



SPOT 2 : WEATHERE DGNEISS

Weathered gneiss refers to, a type of metamorphic rock, that has undergone weathering processes. Gneiss typically forms from the metamorphism of pre-existing rock, such as granite or sedimentary rock, under high temperature and pressure conditions. The Parseoni area, located in the region of Parseoni India, is known for its geological formations, including weathered gneiss. Gneiss in this area has likely undergone significant weathering processes due to environmental factors such as rainfall, temperature fluctuations, and biological activity over time. Weathered gneiss in the Parseoni area might exhibit distinctive characteristics resulting from this weathering. This could include a more rounded appearance, altered mineral composition, and possibly a different coloration compared to fresh gneiss.

Additionally, weathering may have led to the formation of soil rich in minerals derived from the breakdown of the gneiss, which can influence local ecosystems and agriculture.
Weathered gneiss, like any weathered rock, holds significance and finds various uses due to its altered physical and chemical properties. Overall, weathered gneiss plays a significant role in geological process land uses and human activities, making it an important resources and subject of study in various fields.

SPOT 3-ERODED BIOTITE GNEISS

Eroded biotite gneiss is a type of metamorphic rock characterized by its distinct banding.

which results from the recrystallization of minerals under extreme heat and pressure dip within the Earth's crust. Biotite gneiss contains significant amounts of the mineral biotite, along with other minerals such as quartz, feldspar, and sometimes amphibole.

Overtime, erosion processes like wind, water, and ice wear away at the surface of the rock, gradually breaking it down into smaller particles and transporting them away. This erosion can occur through various mechanisms such as abrasion, chemical weathering, and biological activity.

As the outer layers of the biotite gneiss are weathered away, the underlying rock becomes exposed. This can lead to the formation of unique geological features such as outcrops, cliffs, and rock formations, depending on the local geology and environmental conditions.

The eroded biotite gneiss may undergo further weathering and transportation processes, eventually contributing to the formation of sedimentary deposits elsewhere. These sediments can become lithified over time through processes like compaction and cementation, forming new sedimentary rocks.

Overall, the process of erosion plays a crucial role in shaping the Earth's surface and recycling geological materials, including eroded biotite gneiss into new rock formations over geological time scales.The age of the eroded biotite gneiss of the Parseoni area is Proterozoic and forms the basement of the oldest rock formation

SPOT 4: MARBLE

Marble is a metamorphic rock formed from the metamorphism of limestone or dolomite rock. The process of metamorphism occurs when pre-existing rocks undergo high temperatures and pressures deep within the Earth's crust causing their mineral composition and texture to change.

Limestone, which is primarily composed of the mineral calcite, under goes metamorphism to become marble. During this process, the calcite crystals in the limestone recrystallize and interlock, resulting in a denser, harder, and more crystalline structure characteristic of marble.

Marble typically exhibits a range of colors, including white, gray, black, pink, green and even blue, depending on the impurities present during its formation. The veining patterns seen in marble are often the result of mineral impurities or irregularities in the original limestone.

In the figure below we can see Manganese (black color) of Lohangi formation associated with Marble and can be scratched by nail or can be verified by doing an acid test.

The basin is enclosed towards north because materials are supplied from the southern direction.The Manganese in the marble comes from the syn-genetic sediments where in the silicais replaced by MnO3.Because of this the carbonate is present as a very small thin layer.

SPOT 5: - Z-TYPEFOLD

A Z-fold is a type of structural fold that occurs when rock layers are bent into a zigzag pattern resembling the letter Z when viewed from the side. This folding typically happens due to compressional forces acting on the Earth's crust, which can occur during tectonic plate collisions or other geological processes.

Z-folds are characterized by alternating anticlines (upward arching folds) and synclines (downward arching folds) that create a repeating pattern resembling the letter Z. The anticlines are convex upward, while the synclines are concave upward. This folding pattern can be observed in various scales, from small-scale features in rock outcrops to large-scale structures in mountain ranges.
The formation of Z-folds is influenced by several factors, including the mechanical properties of the rocks involved, the direction and intensity of the compressional forces, and the presence of pre-existing weaknesses or faults in the rock layers. These folds can provide valuable information about the tectonic history and deformational processes that have affected a particular region over geological time.

Studying Z-folds can help geologists understand the deformational history of an area, including the direction and magnitude of the forces that caused the folding. as well as the timing of these geological events. This information is crucial for reconstructing past tectonic processes and interpreting the geological evolution of a region. Additionally, Z-folds may also have implications for natural resource exploration, as they can influence the geometry and orientation of underground rock formations that may contain valuable mineral deposits or hydrocarbon reservoirs

SPOT 6: -MARBLE WITH PEGMATITIC INTRUSION

A pegmatite is an igneous rock showing a very coarse texture with large interlocking crystals. Most pegmatites are composed of orthoclase, quartz and have a similar solid composition compared to granite.

The zero-fault pegmatite is alargeun zones pegmatite or graphic granite that is well exposed.

The geochemical data has facilitated development of a three step process responsible for its origin.

1. An atectic fusion of a potassic meta rhyolite.

2. Intrusion of granite into marble, during which the anatectic melt underwent dense mineral fractionation resulting in the formation of zero fault pegmatitic fault.

3. The melt encountered CO_2vapours which reduced H_2Oactivity, increased solidas temperature and resulted in significant cooling.

4. This led to rapid crystallization resulting in a graphic texture.

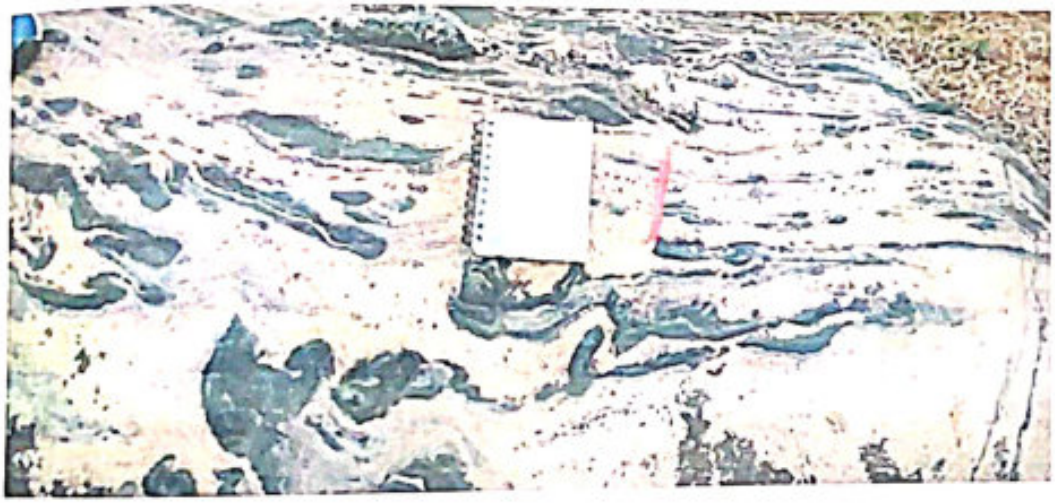
5. The placement of graphic granite into marble common among pegmatites.

SPOT 7: - PENECONTEMPORANEOUS STRUCTURES

Penecontemporaneous deformation structures comprise disturbed, distorted, or deformed

sedimentary layers produced by inorganic agencies. These features have been formed at the time of or very shortly after deposition of sediment, but in any case, before the consolidation of sediment. Generally, such deformation features are of local character, being primarily confined to a single bed within undeformed beds.

They are intraformational meaning they are bounded above and below by relatively undeformed strata. Penecontemporaneous folds and faults are usually chaotic. The fluid pressure in the layers keeps the layers apart. They are formed almost at the same time as the deposition of the original layers.



CONCLUSION

At Parseoni, we observed the Stratigraphic succession of Sausar Group and various types of rocks such as mica schist, marble, biotite gneiss, pegmatite and also different types of structural features like folds and joints and economically important ore minerals like Braunite.

We learnt about the various characteristics of these rocks and the stratigraphic succession of the Sausar group which was very helpful for us as it forms a part of our syllabus.

The trip to Parseoni also gave us an idea of conducting field work and the various aspects of field work such as sampling of the rocks, drawing geological field diagrams, measuring dip and strike etc.

All in all, the trip to Parseoni was a fruitful one.

Enclosure of Photo of the Visit

Science College, Congress Nagar Nagpur SEAL

Principal
S.S.E.S. Amravati's
Science College, Nagpur

IQAC Coordinator
S.S.E.S.A's
Science College, Nagpur

Shri Shivaji Education Society Amravati's

SCIENCE COLLEGE

Congress Nagar, Nagpur - 440 012 (M. S.) INDIA.

Study Tour Report

SHRI SHIVAJI EDUCATION SOCIETY, AMRAVATI

SCIENCE COLLEGE

CONGRESS NAGAR, NAGPUR-440012

CERTIFICATE

DEPARTMENT OF BOTANY

This is to certify that the study tour report on " Pench Forest, Ghogara Mahadev, Shivtekadi" has been carried out by the students of B.Sc 2nd year (CBG) during the academic year 2023-2024

Signature of Teacher

Dr. R.P.Sonwalkar

Assistant/Associate Professor
Department of Botany
S.S.E.S.Amt's Science College,
Congress Nagar, Nagpur.

Prof. R. N. Deshmukh
HEAD
DEPARTMENT OF BOTANY
SHRI SHIVAJI EDUCATION SOCIETY
AMRAVATI'S SCIENCE COLLEGE
CONGRESS NAGAR, NAGPUR.

DEPARTMENT OF BOTANY
STUDT TOUR
COMPLETION CERTIFICATE

This is to certify that **Sayali Kambale**, a student of **B.Sc. 2nd Year (CBG)**, successfully participated in the study tour organized by the Department of Botany for the academic session **2023-2024**.

Signature of Teacher

Dr. R.P.Sonwalkar
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Prof. R. N. Deshmukh

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AMRAVATI'S SCIENCE COLLEGE
CONGRESS NAGAR, NAGPUR

ACKNOWLEDGEMENT

It is great pleasure that I express my deepest gratitude to the Department of botany of shri Shivaji science college Nagpur for organizing Botanical study tour at shiv Tekadi, Pench Forest (NavegaonKhairi)GhograMahadev.Mysincerethanksgotomy guides sir and our study tour Co-Ordinator prof.Dr. RAJENDRA Deshmukh sir and Prof. Dr. Reshma Sonwalkar Mam Prof. Dr. Sharayu Deshmukh Mam for giving us time to time suggestions adviceandinspirationfor makingthetour Grandsuccess.Iwould also take this opportunity to thanks my classmates for their kind co-operation rendered to me throughout the tour.

STUDY TOUR REPORT SUBMITTED BY FOLLOWING STUDENTS

1. **SayaliKamble**

CONTENT

AIMS AND OBJECTIVES OF THE STUDY TOUR

To observe and collect the plants species from study site. To Study the Natural habitat and characters of the plants found in the area. To collected plant may be kept and used for reference studies.

REQUIRMENTS FOR THE FIELD COLLECTION

- Forceps
- Scissors
- Plasticcontainers
- Scales
- Notebook
- Pen
- Pencil

SHRI SHIVAJI SCIENCE COLLEGE NAGPUR

DEPARMENT OF BOTANY

INTRODUCTION

- Field study is essential part of Botany. The natural Environment i.e. the Surrounding where we all interact the plants in their natural Habitat is one of the most interesting things that is needed to be studied by the students.

- **"LIFESCIENCES"**StudyingplantsintheirnaturalhabitatE nhances our knowledge that is learn from the classroom discussion and Laboratory Experiment…

- From Botany Department shri Shivaji Science college Congress Nagar Nagpur made students of the $1^{st}2^{nd}3^{rd}$year of the botany (CBM) (CBZ) (CBG) Group so happy. Our joy to knew no bounds when the spot was fixed toshivTekadi,PenchForest(NavegaonKhairi)GhograMahadevwhichi son the 93J5+3R8 Parashivani Maharastra-441105

- AnApprehensive Knowledge of things are always required for students to start a particular study of a particular site in their natural environment so classroom study and field study are complementary to Environment to each other's and we cannot ignore any one of them. Hence Keeping these two thingsinmindsinviewthisstudy tourorganizedbythedepartmentofbotany Shivaji science college as per syllabus prescribed by the Nagpur (RTMNU) University…

INTRODUCTION "SHIVTEKDI"

- Tekdi is small village/hamlet in Parseoni Taluka in Nagpur District of Maharashtra State India. It comes under Tekdi Panchayath.Itbelongsto NagpurDivision.ItisLocated35KMTowardsNorthfromDistricthead-quartersNagpur.831KM From state capital Mumbai. Tekdi pin code is 441404 and postal head office is Kamthi Colliery.

- Tekdi surrounded byRamtekTaluka towards East SaonerTaluka Towards west. Kamptee Taluka towards south, NagpurTaluka towards South.Ramtek, Kamptee,savner,NagpurarethenearbycitiestoTekdi.TekdiLocallanguageisMarathi Tekdi villageTotalPopulationis 352 and the number of houses is 79. females Population is 48.3%Village literacy rate is 67.0% and females Literacy rate is 29.8% Amdi Railway Station is the very near by railway to Tekdi.Ramtek, Kamthi, Nagpur, Khapa are the nearby towns to Tekdi having road connectivity to Tekdi.

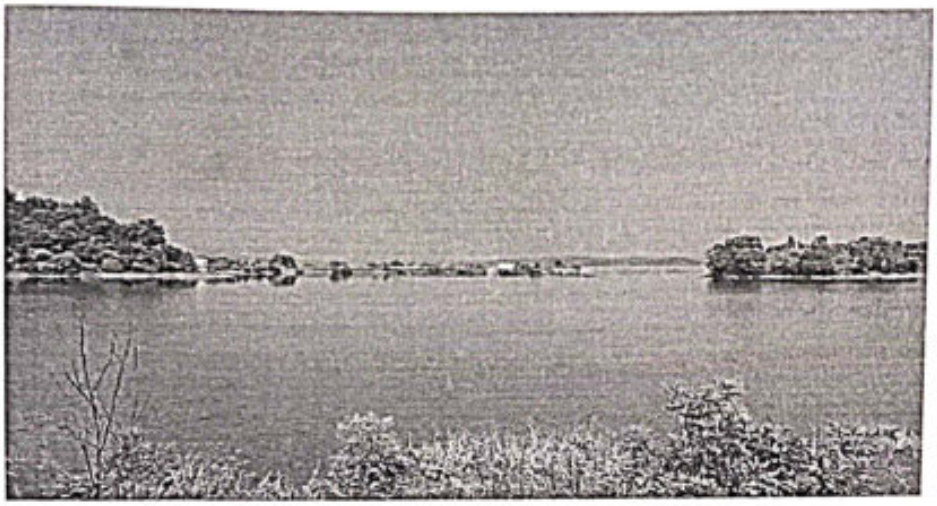
- **LocalityName:Tekdi**
- **TalukaName:Parseoni**
- **Constituency:Ramtek**
- **District:Nagpur**
- **State:Maharashtra**
- **Region:Vidarbh**
- **Division:Nagpur**
- **Language:Marathi,Hindi**
- **Date:Monday 16oct 2023**
- **TimeZone:IST(UTC+5:30)**
- **Elevation:310Meters,abovesealevel**
- **Telephonecode/stdcode:07102**
- **Pin code:441404**

- **Temperature:29.0C**
- **Humidity:41%**
- **Wind:1.07Mt/sectowards South**
- **StationName:"Mansar"**

INTRODUCTION"GHOGRAMAHADEV"

- Ghogra Mahadev is a Hindu temple dedicated to Lord Shiva, located in the parashivni Tehsil of Nagpur district, Maharashtra,India.ItispopulardestinationforHindusandisalsoknownforit snaturalbeauty.TheTemple issituated on a rockyhillock, and is surrounded by a maze of white rocks.
- AStream of water flows throughthe rocks, creating a beautifulwaterfall. TheTemple is believedto be very ancient about 1000 years old making it one of the oldest temples in the state of Maharashtra. The Shivling in the temple is believed to be very powerfulManifestationofShiva.DevoteescomesfromalloverthestateofMaharas htratoworshipatthetemple.They pray for shiva s blessings and they seek his protection from evil.
- Thetempleisespeciallycrowded duringtheShivaratrifestivalinFebruaryormarch.ShivratriisamajorHindufestiv althat celebrates the nightof shivas marriage to Parvati.During shivratri,devoteesfast and prayto Shiva. Theyalso visittemples dedicatedto shiva, such as Ghogra Mahadev. In addition to its religious significance ghogra Mahadev is also a popular tourist destination. The natural beauty of the place is simply stunning. The rocky formations the flowing river,andlush vegetationmakefortrulyunforgettableexperiences.therocky formationsaroundthetemple resembles a maze whichis one of the things that makes the place unique.

INTRODUCTION "NAVEGAON-KHAIRI DAM"



Location:OntheKanhanriver **Canal breaches**:Thedamcanal has experienced breaches in the past Navegao khairi Dam, also called Pench Dam, is on the Pench River near Parshivni in the state of Maharashtra, India. The dam was constructed for irrigation, and supplies water to twodistrictsofMaharashtra,NagpurandBhandara.Thedamisinthe West PenchNational Park Range, surrounded by forested hills, and is 54 km north of Na

Tephrosia purpurea

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Rosids
Order:	Fabales
Family:	Fabaceae
Subfamily:	Faboideae
Genus:	*Tephrosia*
Species:	***T. purpurea***

Binomial name

Tephrosia purpurea
(L.) Pers.

Tephrosia purpurea is a species of flowering plant in the famy Fabaceae, that has apantropicaldistribution.Itis acommonwastelandweed.In many parts it is under cultivation as green manure crop. It is found throughout India and Sri Lanka [1] in poor soils.

Holy Basil

Scientific classification	
Kingdom:	Plantae
Clade:	Tracheophytes
Clade:	Angiosperms
Clade:	Eudicots
Clade:	Asterids
Order:	Lamiales
Family:	Lamiaceae
Genus:	*Ocimum*
Species:	*O. tenuiflorum*

Binomial name

Ocimum tenuiflorum

DracaenaTrifasciata(Snakeplant)

Dracaena trifasciata is a species of flowering plant inthefamilyAsparagaceae, native to tropical West Africa from Nigeria east to the Congo. It is most commonly known as the snake plant, Saint George's sword, mother-in-law's tongue, and viper's bowstring hemp, among othernames.[2]Until 2017, it was known under the synonym Sansevieria trifasciata.[1] This plant is often kept as a houseplant due to its non-demanding maintenance; they can survive with very littleShivTekdi,Parshivni

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