



**SONOPANT DANDEKAR ARTS, V.S. APTE COMMERCE
AND M.H. MEHTA SCIENCE COLLEGE, PALGHAR**

Department of Zoology

PROJECT REPORT

Master of Science Zoology

Academic Year 2022-2023

Prepared by

Department of Zoology

**Sonopant Dandekar Arts, V.S. Apte Commerce and
M.H. Mehta Science College, Palghar**

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Sonopant Dandekar Shikshan Mandali's
Sonopant Dandekar Arts,
V. S. Apte Commerce &
M. H. Mehta Science College, Palghar

Estb.: 14 August 1968

Dr. Kiran Save, Principal

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Ref No.:

Date : 27/06/2023

Notice

Department of Zoology

This is to inform you that all the **Master of Science (Zoology)** students are required to submit the hard copy of your final project report by **12th July 2023**. All submissions should be made to the **Zoology Department, Zoology Laboratory** during office hours from **10.00 am to 02.00 pm**. Ensure your report is properly.

Head of the Department
Department of Zoology

Dr. Kiran J. Save
Principal

PRINCIPAL
Sonopant Dandekar Arts College,
V.S. Apte Commerce College &
M.H. Mehta Science College
PALGHAR (W.R.)
Dist. Palghar, Pin-401404

University of Mumbai




No. UG/20 of 2020-21

CIRCULAR:-

Attention of the Principals of the Affiliated Colleges, the Head University Departments and Directors of the recognized Institutions in Science & Technology Faculty is invited to the syllabus uploaded Academic Authority Unit which was accepted by the Academic Council at its meeting held on 27th February, 2013 vide item No. 4.39 relating to the revised syllabus as per the (CBSGS) of M.Sc. in Course Zoology- Biotechnology – Oceanography and Fishery Science (Sem. III & IV).

They are hereby informed that the recommendations made by the Board of Studies in Zoology at its meeting held on 23rd March, 2020 and subsequently made by the Board of Deans at its meeting held on 20th July, 2020 vide item No. 50 have been accepted by the Academic Council at its meeting held on 23rd July, 2020 vide item No. 4.102 and that in accordance therewith, the revised syllabus as per the (CBCS) of M.Sc. Part-II (Sem. III & IV) in Zoology with specializations viz Animal Physiology, Entomology, Endocrinology and Reproductive Physiology, Environmental Science, Oceanography and Fishery has been brought into force with effect from the academic year 2020-21 accordingly. (The same is available on the University's website www.mu.ac.in).

MUMBAI – 400 032
(1st November, 2020
To


(Dr. Vinod Patil)
I/c REGISTRAR

The Principals of the affiliated Colleges, the Head University Departments and Directors of the recognized Institutions in Science & Technology Faculty. (Circular No. UG/334 of 2017-18 dated 9th January, 2018.)

A.C/4.102/23/07/2020


No. UG/ 20 -A of 2020-21

MUMBAI-400 032

14th November, 2020

Copy forwarded with Compliments for information to:-

- 1) The Dean, Faculty of Science & Technology,
- 2) The Chairman, Board of Studies in Zoology,
- 3) The Director, Board of Examinations and Evaluation,
- 4) The Director, Board of Students Development,
- 5) The Co-ordinator, University Computerization Centre,


(Dr. Vinod Patil)
I/c REGISTRAR

Copy to :-

- 1. The Director of Board of Student Development.,**
- 2. The Deputy Registrar (Eligibility and Migration Section)**
- 3. The Director of Students Welfare,**
- 4. The Executive Secretary to the to the Vice-Chancellor,**
- 5. The Pro-Vice-Chancellor**
- 6. The Registrar and**
- 7 The Assistant Registrar, Administrative sub-centers, Ratnagiri, Thane & Kalyan, for information.**

- 1. The Director of Board of Examinations and Evaluation**
- 2. The Finance and Accounts Officers**
- 3. Record Section**
- 4. Publications Section**
- 5. The Deputy Registrar, Enrolment, Eligibility and Migration Section**
- 6. The Deputy Registrar (Accounts Section), Vidyanagari**
- 7. The Deputy Registrar, Affiliation Section**
- 8. The Professor-cum- Director, Institute of Distance and Open Learning Education,**
- 9. The Director University Computer Center (IDE Building), Vidyanagari,**
- 10. The Deputy Registrar (Special Cell),**
- 11. The Deputy Registrar, (PRO)**
- 12. The Deputy Registrar, Academic Authorities Unit (1 copies) and**
- 13. The Assistant Registrar, Executive Authorities Unit**

They are requested to treat this as action taken report on the concerned resolution adopted by the Academic Council referred to in the above circular and that on separate Action Taken Report will be sent in this connection.

- 1. The Assistant Registrar Constituent Colleges Unit**
- 2. BUCTU**
- 3. The Deputy Accountant, Unit V**
- 4. The In-charge Director, Centralize Computing Facility**
- 5. The Receptionist**
- 6. The Telephone Operator**
- 7. The Secretary MUASA**
- 8. The Superintendent, Post-Graduate Section**
- 9. The Superintendent, Thesis Section**

for information.

UNIVERSITY OF MUMBAI**Syllabus for Approval**

Sr. No.	Heading	Particulars
1	Title of the Course	Zoology (Animal Physiology)
2	Eligibility for Admission	The students who have granted both the Semesters and might have or have not cleared their Semester I and Semester II are eligible.
3	Passing Marks	40% in each Paper
4	Ordinances / Regulations (if any)	-----
5	No. of Years / Semesters	Two Semesters
6	Level	P.G. / U.G. / Diploma / Certificate (Strike out which is not applicable)
7	Pattern	Yearly / Semester (Strike out which is not applicable)
8	Status	New / Revised (Strike out which is not applicable)
9	To be implemented from Academic Year	From Academic Year 2020-2021

Date:

Name of BOS Chairman / Dean: Dr. Bharmal Deelip L.

Signature :

Attest
Dr. Anuradha Mayumdas
Dean, Science & Technology

AC Item No.
XXXXXXXX 2020
Item no.

UNIVERSITY OF MUMBAI



Program: M.Sc.

Course: Zoology **(Animal Physiology)**

Syllabus for Semester III & IV

(Choice Based Credit System
with effect from the academic year 2020-21)

**M.Sc. Part II (Semester III and Semester IV): Zoology (Animal Physiology)
Syllabus Committee Members**

Dr. Nisar Shaikh Chairman, G. M. Momin Women's College, Bhiwandi Dist. Thane, Maharashtra	Dr. Vasanti Katchi Mentor, Former Board of Chairperson in Zoology, University of Mumbai, Mumbai
Dr. Smita Durve Mentor, Former Board of Chairperson in Zoology, University of Mumbai, Mumbai	Dr. Kalpana Pai Mentor, Centre of Advanced Study, Department of Zoology, Savitribai Phule Pune University, Ganeshkhind, Pune – 411007
Dr. G. Gyananath Mentor, Former Director, School of Life Sciences, SRTM University, Nanded.	Dr. Arthur Frank Mentor, Professor and Chair Emeritus, Department of Environmental and Occupational health Dornsife School of Public Health, Drexel University, Philadelphia, PA, USA.
Dr. P. G. Kale Former Head and Professor, Department of Zoology R. J. College, Ghatkopar (w), Mumbai	Dr. Bhavita Chavan Convener, Government of Maharashtra's Ismail Yusuf College, Hardevi Society, Natwar Nagar, Jogeshwari (E), Mumbai – 400 060
Dr. Asha Rao Head and Associate Professor, Department of Zoology, Bhavan's College, Andheri (W), Mumbai – 400058	Dr. Vaishali T. Phusate Head and Associate Professor, Department of Zoology, Ruia College, Matunga, Mumbai - 400 019
Dr. Rupali Vaity Assistant Professor, Department of Zoology, S. I. E. S. College, Sion, Mumbai – 400 022	Dr. Shailesh Anaji Tawade Assistant Professor, Department of Zoology, Patkar College, Goregaon (W), Mumbai - 400 062

working may to be explained by conducting field visits. Neurophysiology and Sensory & effector physiology may be best elucidated with the help of ICT enabled teaching learning methodology along with regular class room teaching.

PSZOPHY402, 'Systems' Physiology IV includes Endocrine Physiology I & II in invertebrates and the vertebrates respectively, Biological rhythms and Physiology of migration. Endocrine Physiology both in invertebrates and vertebrates may be made interesting to the learner not only by chalk and board or ICT method but also with the help of simple laboratory experiments. In 2017, Nobel Prize in Physiology was awarded to Hall, Rosbash and Young for their discoveries in molecular mechanisms controlling circadian rhythm. Such great discoveries and research work should be discussed in the class to motivate and encourage the learners to understand biological rhythms in animals. Having already studied the concept of migration at undergraduate level the learner can comprehend physiology of migration and adaptation in animals not only by lectures but more effectively by screening of various documentaries based on migratory routes of animals with geographical distribution.

PSZOPHY403, 'Recent Trends in Physiology' introduces the learners to the topics of Drug Designing & Modelling, Clinical trials, Clinical trial management & Guidelines and Stem Cell physiology. Drug designing, an integrated developing discipline in an era of tailored drug, involves the study of effects of biologically active compounds in animals whereas the topic on Clinical trials will make the learners understand various types and phases of clinical trials. The syllabus also focuses upon the guidelines to be followed during clinical trials and the management of clinical trials. The topics of this course being newly introduced would require the learner to understand the basic concepts aided with ICT tools, animation, video clips and visits to industry and pharmaceutical company. The concepts of stem cell physiology may be better comprehended by the learners with the help of class room discussions, review of recent research papers and invited talks from expertise of the subject.

PSZOPHY404 consists of '**Instrumentation and Presentation of Scientific data**' which help the students to choose suitable measuring instruments for their applications and understanding of limitations, principles and measurement errors. The students will aware the efficiency of the instruments. Similarly the course also has the unit of presentation of scientific data. Text, tables, and graphs for data and information presentation are very powerful communication tools. They can make scientific report easy to understand, attract and sustain the interest of beneficiary.

Convener and Committee Members

M. Sc. II Zoology Syllabus
Choice Based Credit System
To be implemented from the Academic Year 2020-2021

Animal Physiology: Semester III						
Course Name and Code	Unit	Topic Headings	Credit	Lecture/Week	College Assessment Internal	University Assessment External
Paper I: Systems' Physiology (Invertebrates) I						
PSZOPHY301	1	Nutritive System	4	1	40	60
	2	Respiratory System		1		
	3	Circulatory System		1		
	4	Osmoregulation and Excretory System		1		
Paper II: Systems' Physiology (Vertebrates) II						
PSZOPHY302	1	Nutritive System	4	1	40	60
	2	Respiratory System		1		
	3	Circulatory System		1		
	4	Osmoregulation and Excretory System		1		
Paper III: Biochemical adaptation and Instrumentation						
PSZOPHY303	1	Biochemical adaptation, Oxygen and Environmental Radiation	4	1	40	60
	2	Water, Temperature and Pressure		1		
	3	Instrumentation I		1		
	4	Instrumentation II		1		
Paper IV: Applied Physiology						
PSZOPHY304	1	Cellular Physiology	4	1	40	60
	2	Human Immune Response and Applications		1		
	3	Cancer Cell Biology		1		
	4	Exercise Physiology		1		
Total			16	16	160	240
Practicals						
PSZOPHY3P1	Practicals based on PSZOPHY301		2	4	–	50
PSZOPHY3P2	Practicals based on PSZOPHY302		2	4	–	50
PSZOPHY3P3	Practicals based on PSZOPHY303		2	4	–	50
PSZOPHY3P4	Practicals based on PSZOPHY304		2	4	–	50
Total			8	16	–	200
Grant Total			24	32	160	440

PAPER 4: PSZOPHY404

INSTRUMENTATION AND PRESENTATION OF SCIENTIFIC DATA

Unit 1: Instrumentation

(15 L)

Objective

- *To learn how to design and build instruments for laboratory measurement.*
- *To understand fundamental principles of operation.*

Desired Outcome

- *The learner will understand methods for operation of instruments and data analysis.*
- *The learner will understand how instrumentation can advance scientific research.*

1.1 Centrifugation:

- Principle and applications of Centrifugation
- Differential and density gradient Centrifugation

1.2 Electrophoresis:

- Principle
- Structural components
- Applications

1.3 Chromatography:

- Principle and applications
- Adsorption
- Ion exchange
- Gel permeation
- Affinity

1.4 Spectrophotometer:

- Principle
- Applications

1.5 pH meter

- Principle
- Applications

1.6 Microscopy

- Binocular
- Trinocular

Unit 2: Presentation of Scientific data

(15 L)

Objective

- *To aware the students for good practice in data presentation.*
- *To aware the students to use different data presentation formats.*

Desired Outcome

- *The students will familiarize to explain their research data by using different techniques for presenting their scientific data.*

2.1 Types of presentation:

- Oral
- Poster
- Written
- Audio-visual

Aids for presentation

2.2 Preparing the manuscript

- Guidelines for authors
- The IMRAD format

2.3 Title, Byline, Abstract and Summary, Keywords

2.4 Introduction:

- Defining the problem
- Literature survey
- Justification of study

2.5 Materials and Methods:

- Contents
- Sources
- Procedures
- Techniques
- Reproducibility
- Significance

2.6 Results:

- Text
- How to present data
- Tables and illustrations
- Writing captions
- Labels and legends

2.7 Discussion:

- Components and Sequence
- Analysis, Comparison and Integration of Data
- Likely Sources of Errors in Results

2.8 Conclusions and significance

Unit 3: Project

(30 L)

Objective

- To familiarize learner for analyzing a scientific occurrence with an investigation or to solve a problem with an invention.

Desired Outcome

- Research expands the current state of knowledge (at a certain cost) of the learners.
- Experimental findings that may yield new insights or lead to other research among the learners.

1. Dissertation 60 Marks
2. Examination 50 Marks

Guidelines to the Project:

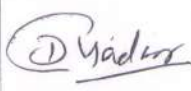
1. The Project shall include:

- Title of the Project
- Aims, Objectives and Rationale
- Materials and Methods
- Observation and / Results
- Interpretation of Observation / Results and Discussion
- Conclusion and / Recommendation
- Relevance of Work / Justification of Work with Project title
- Relevant References

2. **The project must be type-written using computer and printed for binding.**
3. **No minimum or maximum limit of the number of pages is defined since the volume of the proposal is dependent on the scope of the selected topic.**
4. **Name of the mentor may be reflected on the first page of the project along with the student's names.**
5. **The hard copy of proposal must be retained and submitted along with the dissertation in the examination for the reference of the external examiner/s.**
6. **Student should prepare individual power point presentation (PPT) on the project and must present it in front of examiners at the time of examination.**
7. **The project will be prepared individually by students.**

Sonopant Dandekar Shikshan Mandali's
S.D. Arts, V.S. Apte Commerce, M.H.Mehta Science College, Palghar

List of research projects completed by the students at Master's Degree Part-II in the subject of Zoology for academic year 2022-23.

Sr.No.	Roll Number	Name of the student	Title of the project	Signature
1.	47003	Mr.Harshal P.Kudu	Diversity Of Insects In Apti (Khurd) Village Of Vikramgad Tehsil, Palghar."	
2.	47015	Mr.Ajay U.Patel	Estimation of Protein and Carbohydrate from different leafy vegetables.	
3.	47014	Mr.Alok S.Tiwari	Comparative Study Of Protein And Calcium Content In Goat, Cow, Buffalo And Packaged Milk [Amul,Shrina	
4.	47013	Ms.Bhakti A.Shastri	Biodegradation of synthetic dyes of textile effluent by bacteria	
5.	47006	Ms. Divya Y.Yadav	Determination of protein content and glycemic index of different cereals and pulses to design healthy diet chart for diabetes.	
7.	47019	Ms.Smita Tiwari	Quantitative analysis of protein from different types of hen's egg	
8.	47007	Ms.Saloni B.Shukla	Cholesterol Lowering Property Of Garlic (Allium Sativum) In Patients With Hypercholesterolemia.	
9.	47011	Mr.Jitesh V.Mere	Estimation of Heavy metals present in Mudskipper Liver, Gill & Muscles organs.	
10.	47010	Mr.Mayur Ramdas Kamdi	To Study Diversity Of Mangroves And Associated Molluscans At Shirgav Of Palghar District	
11.	47005	Mr.Pratik V.Gharat	Tidal migration of fishes.	
12.	47012	Ms.Rutuja Mangesh Patil	Estimation of protein content in muscle tissues of wet fish species inpalghar area.	
13.	47004	Ms.Pranoti P.Kadam	Identification of Molluscan Diversity of Kalamb Beach and Bhuigaon Beach".	
14.	47001	Ms.Swapnali Jagtap	Estimation Of Protein Content In Muscle Tissues Of Three Different Dry Fishes Species In Palghar Area.	

PROJECT TITLE

COMPARATIVE STUDY OF PROTEIN AND CALCIUM CONTENT IN GOAT, COW,
BUFFALO AND PACKAGED MILK [AMUL, SHRINATHI]

A DESERTATION SUBMITTED
TO THE UNIVERSITY OF MUMBAI
FOR THE DEGREE OF
MASTER OF SCIENCE
IN
ZOOLOGY

SUBMITTED BY

MR. ALOK S. TIWARI

DESIGNATION: - M.Sc (ANIMAL PHYSIOLOGY)

DEPARTMENT: - ZOOLOGY

SONOPANT DANDEKAR ARTS, VS APTE COMMERCE & M. H. MEHTA SCIENCE
COLLEGE PALGHAR (PALGHAR WEST)

UNDER THE GUIDANCE OF

DR. HARSHAD VANMALI

(DEPARTMENT OF ZOOLOGY)

SDESM COLLEGE PALGHAR (WEST)

M.Sc. ZOOLOGY 2022 - 23

08/05/2024

12:51



PROJECT TITLE

**COMPARATIVE STUDY OF PROTEIN AND CALCIUM CONTENT IN GOAT, COW,
BUFFALO AND PACKAGED MILK [AMUL,SHRINATH].**

A DESERTATION SUBMITTED
TO THE UNIVERSITY OF MUMBAI

FOR THE DEGREE OF
MASTER OF SCIENCE

IN

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SUBMITTED BY

MR. ALOK S. TIWARI

DESIGNANATION: - M.Sc (ANIMAL PHYSIOLOGY)

DEPARTMENT: - ZOOLOGY

**SONOPANT DANDEKAR ARTS, VS APTE COMMERCE & M. H. MEHTA SCIENCE
COLLEGE PALGHAR (PALGHAR WEST)**

UNDER THE GUIDANCE OF

DR.HARSHAD VANMALI

(DEPARTMENT OF ZOOLOGY)

SDSM COLLEGE PALGHAR (WEST)

M.Sc. ZOOLOGY 2022 - 23



CERTIFICATE

This is certify that the thesis entitled "Comparative study of protein and calcium content in Goat, Cow, Buffalo and Packaged milk. {Amul, Shrinath}" is bonafied record of work carried out under my guidance and supervision and that no part thereof has been presented for any degree, diploma or similar title of any other University.

HSV
10/7/2023

(Dr. Harshad S. Vanmali)

Guide

P. J. Jambale
15.07.2023

EXTERNAL EXAMINER

15 JUL 2023

INDEX

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Declaration

I, Alok S Tiwari, a student M.Sc. Part 2 in Animal Physiology in the Department of Zoology, declare that the project titled "Comparative Study of Protein and Calcium Content in Goat, Cow, Buffalo Milk, and Packaged Milk" is my original work and submitted by me for the academic year 2022-23.

This project will be conducted during the academic year 2022-2023 under the guidance and supervision of Dr. Harshd Vanmali,. I am grateful for their support and guidance throughout the project.

I, hereby affirm that all the information provided in this project declaration is accurate and true to the best of my knowledge.

Acknowledgement

I would like to express my heartfelt gratitude and appreciation to everyone who helped me complete my project titled "Comparative Study of Protein and Calcium Content in Goat, Cow, Buffalo Milk, and Packed Milk" during my M.Sc. Part 2 (Animal Physiology) at SDSM Palghar West.

First and foremost, I am grateful to Dr. Harshd Vanmali, my project guide, for their excellent direction, constant support, and mentorship during this research endeavour. Their skills, wide knowledge, and smart suggestions have been critical in determining the project's direction and quality. I appreciate their ongoing availability, patience, and support, which have inspired me to overcome obstacles and strive for excellence.

I'd like to express my heartfelt gratitude to the faculty members of the Department of Zoology for creating a welcoming academic environment and for providing me with the essential knowledge and abilities.

I am grateful to the laboratory's personnel and technicians for their assistance with experimentation, data gathering, and analysis.

I'd also like to thank my classmates and friends for their encouragement and camaraderie during the project. Their conversations, criticism, and joint efforts have expanded my knowledge and improved the overall quality of this research.

Furthermore, I would like to thank the SDSM Palghar West authorities for providing the required facilities, resources, and infrastructure for the completion of this project. Access to the library, laboratory equipment, and other research materials aided in the successful completion of this study.

I'd want to thank and honour everyone stated above, as well as everyone else who has helped me finish this project, directly or indirectly. Their assistance and participation have been priceless, and I am eternally thankful.

Abstract

This comparative study aims to evaluate the protein and calcium content in goat, cow, and buffalo milk, focusing on their casein protein and calcium concentrations. The milk samples were collected from the Ganesh nagar, Boisar East region of Palghar. The casein protein content in goat milk was found to be 5.406 gm/100ml, while cow milk contained 3.766 gm/100ml of casein protein. Buffalo milk exhibited the highest casein protein concentration with 6.505 gm/100ml, whereas Amul milk had 2.94 mg/l and Shrinath milk had 3.45 gm/100ml of casein protein.

Regarding calcium content, goat milk contained 50mg/L, cow milk contained 67mg/L, and buffalo milk exhibited the highest calcium concentration with 82.96mg/L, Amul milk had a calcium content of 56mg/L, while shrinath milk had 56.1mg/L.

The findings of this study provide valuable insights into the protein [Casein] and calcium ingredients of these commonly consumed milk types. Understanding the variations in these nutrients can aid in making informed dietary choices and addressing specific nutritional needs.



INTRODUCTION

Milk is nature's most complete food and the products of milk are considered to be the most nutritious of all. It is now recognized to be more than a source of nutrients for the healthy growth of children and nourishment of adult humans (Navale and Gupta, 2016). Goats form an important component of livestock industry and play vital role in the socio-economic structure of rural people. India has the second highest goat population in the world which is around 120 million constituting about 15% of worlds goat population (Aroral, *et al* 2013). Cow milk is widely consumed by infant and adults to meet their basic nutritional needs. Cow milk is the most universal raw material for processing dairy products resulting in a broadest spectrum of manufactured dairy products (Dandre S.U *et al*, 2014). It is the basic of animal origin used for the nutrition of born calves (INNIS 2007) and for human consumption as well (Haug *et al*, 2007). In India, it is generally observed that in the north and west the cow are better milkers, but as one gets to the south and east the milk producing quality deteriorates (Sreenivasaiah.K *et al*, and Chellarkumar.A, 2016). However, there are many people who cannot drink cow milk because of a milk allergy. Goat and buffalo milk is can be useful for them (Hajiraostambo.B, 2009).

Buffalo milk has long been valued by its important chemical composition determining nutritive properties and suitable in the manufactured of traditional as well as industrial dairy products. Recently buffalo milk's constituents their nutritional importance and attention (Ahmed s *et al.*,2014).

Buffalo milk is higher in protein content, fat,lactose, total solids, vitamins and minerals the flavour and taste (Menard *et al*, 2010: Hussian *et al*, 2011). Similar to other mammals, buffalo milk includes casein and whey protein. The dissimilar distribution of alfa s1, alfa s2, β and k-casein in buffalo milk protein compared to Holstein proteins has been reported (Bonafatti *et al*, 2013: Li. S *et al.*, 2016).

Buffalo milk contains a relatively high amount of calcium compared to other animal. Depending on the variation of calcium content and overall milk quality the recipe may differ throughout the year (Elvingson. L, 2013).

Goat milk is highly nutritious that it can actually serve as a substitute for a meal. It is also preferred due to its low-fat content and toxins present in the body (Getaneh *et al*. 2016). Comparative advantages are the economic principle for allocation of resources as the free-market economy system is applied (Ibrahim Soliman, 2008). The nutritional and health benefits of goat milks are related to a

number of medical problems, for most being food allergies and also a substitute for those who suffers from cow milk allergies (Getaneh *et al.*, 2016).

Modern industrial processes use milk to produce casein, whey protein, lactose, condensed milk, powdered milk and many other food additives and industrial products. Comparative study between the different types of milk is not available much, so present study was carried out to compare the vitamins present in the milk and to check the quality of milk (Navale and Gupta, 2015).

The major deriving forces for manipulating the composition of included the aims of improving the manufacturing (Tripathi MK, 2014). Because of the increasing of people awareness for food safety, knowing the chemical composition of buffalo milk has a great significance for further development of hygienic processing into quality products for the consumer (Mihaiu R. *et al* 2010: Ahmad *s et al*, 2013). The protein content of buffalo milk is higher than in cow, -80% are caseins and -20% are whey proteins with traces of minor proteins (Laxminarayana and Dastur, 1968: Sirryet al, 1984: sahai. 1996: Ahmad *et al*).

Milk proteins are highly nutritious that effective supplement poor quality vegetable proteins in a mixed diet% milk protein and peptides have several therapeutic and prophylactic properties and protect against gastrointestinal disorders, hypertension and enteric infections. (Singh A and Pratap A, 2012).

The milk concentration of calcium varies with time of the year as well as with stage of lactation. (Elvingson.L, 2013). The chemical composition of buffalo milk is different from the cow milk. (Spanghero and Susmel, 1996; zicarelli, 2004; Khan et al, 2007; Elvingson.L, 2013). Buffalo milk has higher concentration of fat, protein, ash, lactose and calcium than cow's milk (Ahmed et al, 2008; Elvingson L, 2013). The concentration of protein is 30%, calcium 70% and Elvingson L, 2013). The relationship between milk products consumption and possible phosphorus 30% higher in buffalo milk than cow milk (Spanghero and Susmel, 1996; negative health effects is still not fully explored. For example, the interaction between carbohydrate and protein whose effect have not been assessed. (Ligia. R, 2013).

According to world health organisation (WHO) standard and other scientific work the quality milk should content 26% fat, 15% protein 617 IA 771 SNE The pH 6.6 ensures the milk freshness at boiling point 100 c /177c Khalid A 2006 Khan. Zed. A 2007, Mohammad IMRANI, *et al.*, The main factors that result from variation in milk are entirely related with the ruminant's diet.

knowledge, the human diet should incorporate around 60 nutrients that are essential for growth. development and functioning of the body, the milk is the nutritionally richest food of animal origin. The biological value of milk is determined by the content of bioactive components that offer health benefits. (Rekleswsk *et al.* 2005; Wong *et al* 2006 Micinski J *et al*, 2013), Dietary calcium or dairy calcium has a positive effect on obesity. and the controversy relating to the result of clinical trials has been discussed in the following reviews (Barba, Russo 2006 Micinski J. 2013).

Milk protein polymorphisms are involved in human nutrition in various ways. Three crucial aspects include; 1) The hypoallergenic properties of particular types of milk 2) The release of peptides with biological functions from milk protein. 3) The solution of bovine milk protein variants and human lactose tolerance. (Caroli A. Met 2009).

Protein of the goat milk are important source of the angiotensis converting enzyme ACT Antihypertension peptide and inhibitory peptides, they are able to control microbial infections and also provides disease defence. (Sachin. S *et al* 2017). For optimal result, high calcium intake should be accompanied by an increase in blood vitamins D concentration may reach 30 nanograms per ml. (Micinski J, 2013). Milk contains vitamins those play prophylactic role in cancer, autoimmune diseases, heart diseases etc.(Navale and Gupta, 2015). The symptoms like gastrointestinal disturbance, colic, diarrhoea, constipation and respiratory problems can be eliminated when out milk is fed to the infants. Regular intake of goat milk significantly I improves the body weight gain, improved mineralization of skeleton, increase blood serum vitamins, minerals and haemoglobin levels.(Getaneh G *et al*, 2016).

Casein is one of the main components of milk in addition to sugar i.e. lactose vitamins, minerals and fat. Casein is highly digestible in the intestine and has high quality source of amino acids needed for the growth and development of the nursing young ones. Casein molecules can be precipitated from milk by adding acid, similar to that happens inside the stomach when milk is consumed.

Casein micelles are smaller, spherical, stable and dynamic structures. The size of micelles ranges between 0.04 and 0.3 μm in diameter. Its porous structure helps in allowing the water phase to move freely in and out of the micelle. Casein can be heated to boiling temperature or can be cooled, dried and also reconstituted without any adverse effects. It is used for manufacturing nutritional products. Different combinations of controlled acid precipitation of casein are the secrets of the cheese industries

Packaged Milk Brands :

Amul and Shrinath are well-known brands that offer packaged milk products. Packaged milk refers to milk that has undergone processing, pasteurization, and packaging to ensure safety, extend its shelf life, and make it convenient for consumers to purchase and use.

Amul is a popular dairy cooperative brand in India, known for its wide range of milk and milk-based products. They offer packaged milk in various forms such as Amul Gold, Amul Taaza, Amul Slim n Trim, Amul Shakti, and more. These products come in different fat percentages, catering to the preferences of different consumers.

Shrinath is another brand that provides packaged milk.

Packaged milk generally undergoes pasteurization, a process that involves heating the milk to kill harmful bacteria while retaining its nutritional value. It is then packaged in containers like cartons, bottles, or pouches, ensuring that it stays fresh for a longer duration.

Consumers prefer packaged milk for its convenience, longer shelf life, and the assurance of safety and quality provided by reputable brands like Amul and Shrinath.

AIMS AND OBJECTIVE

AIMS:-

- The present study aims to investigate and compare the nutritional content of milk from different milk samples such as cow, goat, buffalo, Amul and Shrinath etc.
- To compare the protein and calcium content of goat, cow, and buffalo and packaged milk and determine which milk contains the highest amount of these nutrients.
- To compare the nutritional value of milk from cow, goat, and buffalo packaged milk.

OBJECTIVE:-

Milk nutrient such as calcium, protein, casein and colour have been observed by and determined for various samples of milk i.e. Buffalo milk, cow milk and goat milk. To collect milk samples from different sources, i.e., goat, cow, buffalo, and packaged milk.

To analyze the protein content of each milk sample using standard methods such as complexometric method. {Complexometric Method}

To determine the protein[Casein] content of goat, cow, buffalo, and packaged milk using standard biochemical methods. {Qualitative estimation}

To determine the calcium content of goat, cow, buffalo, and packed milk using complexometric methods. To compare the protein and calcium content in goat, cow, buffalo, and packed milk. To evaluate the nutritional value of goat, cow, buffalo, and packaged milk based on their protein and calcium content.

To provide information that can be used to promote the consumption of milk from different sources based on their nutritional value.

RATIONALE

Milk and its product constitute a rich source of the mineral components that satisfy, phosphorus, potassium, magnesium and sodium. Although animals used for milk include cattle, goats and buffalo, cow's milk is one of the mildest tasting mammals milks the most popular.

Population increased and the importance of calcium and phosphorus for skeletal health become evident. Milk was promoted by public education and Doctor as a rich source of these minerals. Doctors considered milk as an "Indispensible" component of a child's diet based on this association.

This study will create base line for future research and make awareness regarding to properties of milk.

The rationale for conducting a comparative study of protein and calcium content in goat, cow, buffalo milk, and packet milk is to identify the nutritional differences between these sources of milk. This information is essential for consumers to make informed choices about their dietary habits and for nutritionists to recommend the appropriate type of milk for individuals with specific dietary needs.

The study will provide a comprehensive analysis of the protein and calcium content of these types of milk, highlighting any significant differences in their nutritional value. It will help to determine whether goat, cow, or buffalo milk has higher protein and calcium content than packet milk, which is a commonly consumed type of milk.

The study will involve collecting samples of milk from each of the sources and analyzing their protein and calcium content through laboratory testing. The results will be compared, and conclusions will be drawn based on the findings.

Overall, the comparative study of protein and calcium content in goat, cow, buffalo milk, and packaged milk will contribute to our understanding of the nutritional value of different sources of milk.

REVELANCE OF WORK/JUSTIFICATION OF WORK WITH PROJECT TITLE

The relevance of this project is to compare calcium amount in different samples of milk. It is also useful for to estimate the other important nutrient like protein and improve the quality of milk as well. We can also analyse the nutritive value of different milk samples and increase the nutritive value of milk. It is a golden opportunity for the investors to come into these milks business to get advantage from the government initiatives in the current period. In this way we will be able to improve the quality and experimenting diversity of products for the local market and export by better exploiting the uniqueness of these milks.

It can create base line for research in future it may help in bringing profitable change in diary industries. This project will be for the student to use this project as a reference.

The comparative study of protein and calcium content in goat, cow, buffalo milk, and packaged milk is an essential research project that aims to evaluate and compare the nutritional value of different types of milk. This project's relevance lies in the fact that milk is a significant source of protein and calcium, which are essential nutrients for the human body. Understanding the variations in the nutritional content of different types of milk can help individuals make informed decisions about their dietary choices.

Moreover, this project can help in determining the suitability of different types of milk for specific age groups and medical conditions. For instance, individuals with lactose intolerance may benefit from consuming goat's milk, which has lower lactose content than cow or buffalo milk. Similarly, individuals with calcium deficiencies may benefit from consuming buffalo milk, which has higher calcium content than cow or goat milk.

Furthermore, this project's justification is based on the fact that there is limited research on the nutritional content of different types of milk available in the market. Most studies have focused on cow's milk, which is the most commonly consumed milk worldwide. However, with the growing popularity of other types of milk, such as goat and buffalo milk, it is essential to evaluate their nutritional value and compare them to cow's milk.

Overall, this project's relevance and justification lie in its potential to provide valuable insights into the nutritional content of different types of milk and help individuals make informed decisions about their dietary choices.

MATERIAL AND METHODS

➤ PROTEIN:

APPARATUS: Flask, Testtube, Petridish, Beaker, Conical flask, Muslim cloth, Tripod, Spatula, Weighing scale, Oven, Hot water bath.

CHEMICALS: Conectarted nitric acid, 3M Sodium hydroxide, 10% Glacial acetic acid, Ethanol, Diethyl ether and Alcohol 1:1.

Study site:

Sample (Milk) Collected from Ganesh nagar, [Dairy Farm] Boisar West, Palghar

Sample Collection:

From March 2023 to April 2023, Samples were collected from dairy farm with two time intermediate of every month in Sterilized glass bottle.

All the milk samples were filtered to remove insoluble impurity like hair, dirt etc.

Total 10 sample were collected with the categories per to 2 samples like, Buffalo, Cow, Goat and Packaged milks.

100ml of milk sample from every category was took -

1. Cow milk - 100ml in Sterilized glass bottle
2. Buffalo milk - 100ml in Sterilized glass bottle
3. Goat milk - 100 ml in Sterilized glass bottle
4. Amul milk - 100ml in Sterilized glass bottle
5. Shrinath milk - 100ml in Sterilized glass bottle

➤ METHOD:

- ❖ Pour 100 ml milk in a conical flask.
- ❖ Keep the flask containing milk in water bath at 70°-80°C
- ❖ Add acetic acid drop by drop into the milk and stir continuously till the precipitate formation is completed.
- ❖ Keep above solution for some time to cool down to room temperature.
- ❖ A Filter the solution into 250 ml beaker using muslin cloth and squeeze out to remove more liquid.

- ❖ Collect the solid precipitate in 100ml beaker.
- ❖ Add 15 ml of 95% ethanol to solid precipitate and stir for 5 minutes. This is to dissolve fat content present in it.
- ❖ Now, to dissolve additional fats decant the supernatant and add 15 ml of diethyl ether and ethanol 1:1 v/v to the solid. Stir it for 5 minutes.
- ❖ Filter and collect the precipitate in petri dish. Dry the solid precipitate in oven at 80°C. 10. Dried solid is casein. Determine the percentage yield by weighing the casein.



Fig 1 : Breed : Jamnapari Goat



Fig 2 : Breed : Murrah Buffalo



Fig 3 : Amul Milk



Fig 4 : Shrinath Milk

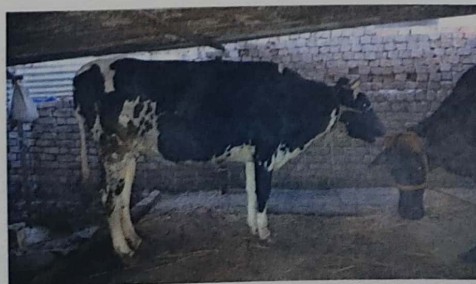


Fig 5 :Breed friesian cow

Qualitative test for casein : Xanthoproteic test:

1. Take a pinch of dry casein in a test tube and add 1 ml of concentrated nitric acid into it. Stir it with glass rod.
2. Keep it in water bath for 5 minutes. White colored solid precipitate changes to yellow color solution.
3. Cool the solution under running tap water. Add a few drops of 3M sodium hydroxide slowly from the rim of the test tube.
4. Canary yellow color confirms that casein is present.

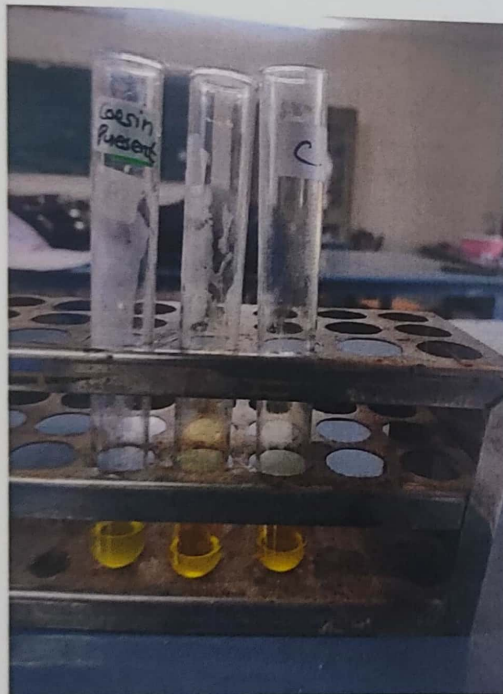


Fig 6 : Canary yellow color confirms that casein is present.

➤ **PRECAUTIONS:**

- ❖ The amino acids, methionine and cysteine, in milk get degraded with exposure to light. This can give bad flavor to milk and loss of nutritional quality. Hence do not keep casein exposed to light.
- ❖ Diethyl ether is highly flammable therefore no flammable substances should be kept nearby.

➤ Calcium:-

❖ REAGENTS ;

EDTA solution, 0.05 M , Sodium hydroxide 1N(Dissolve 40 g of NaOH in distilled water and dilute to 1 litre). S Murexide indicator(Mix 0.2 g of ammonium purpurate with 100 g of NaCl (A. R.) and grind.

❖ PROCEDURE ;

- ❖ Take 100 ml sample in an erlenmeyer flask. If the sample is having higher alkalinity, use smaller volumes diluted to 50 ml.
- ❖ Add 2.0 ml of NaOH solution in the sample.
- ❖ Add 100 to 200 mg of murexide indicator; a pink colour develops.
- ❖ Titrate against EDTA solution until the light pink colour changes to purple.

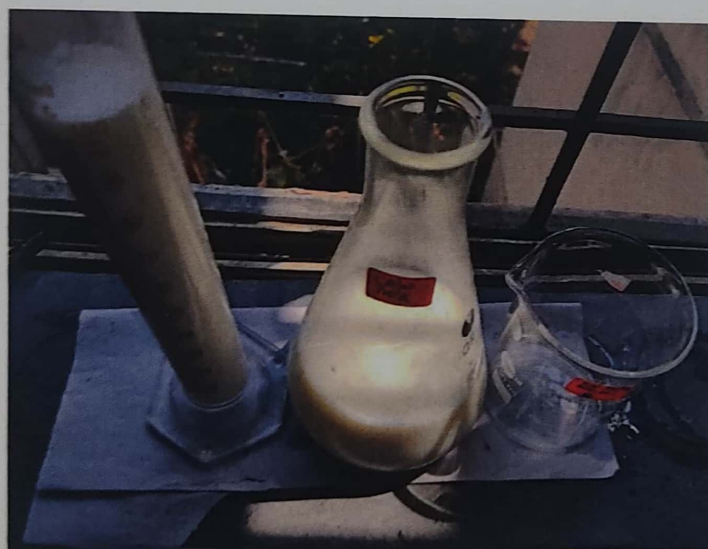


Fig 7 : Milk Sample at room temperature

EXPECTED OUTCOME

- The ingredients level [Casein protein and Calcium] of milk and its constituents may differ from each others.
- The Nutritional elements is both too high and too low.

Observaion Table

Table 1 :- Casein Protein

Table 2 :- Calcium

Table 1. Weight of Casein Protein in different Milk samples :

Serial No.	Milk Sample (100ml)	Weight of casein (g) Sample 1	Weight of casein (g) Sample 2	Mean ($\bar{x} = \sum x/n$)
1	Goat	5.456	5.356	5.406
2	Cow	3.708	3.825	3.766
3	Buffalo	6.491	6.520	6.505
4	Amul	2.93	2.95	2.94
5	Shrinath	3.4	3.5	3.45

Table 2. EDTA volume used for Calcium in different Milk samples :

Serial No.	Milk Sample (100ml)	Sample 1 (end point){ml}	Sample 2 (end point){ml}	Mean ($\bar{x} = \sum x/n$)	EDTA volume used (ml)	Calculation[mg/L] Calcium
1	Goat	12.2	13	12.6	12.6	50
2	Cow	16.2	17.3	16.9	16.9	67
3	Buffalo	20.5	21	20.7	20.7	82.96
4	Amul	13.5	14.5	14	14	56
5	Shrinath	14	14.2	14.1	14.1	56.1

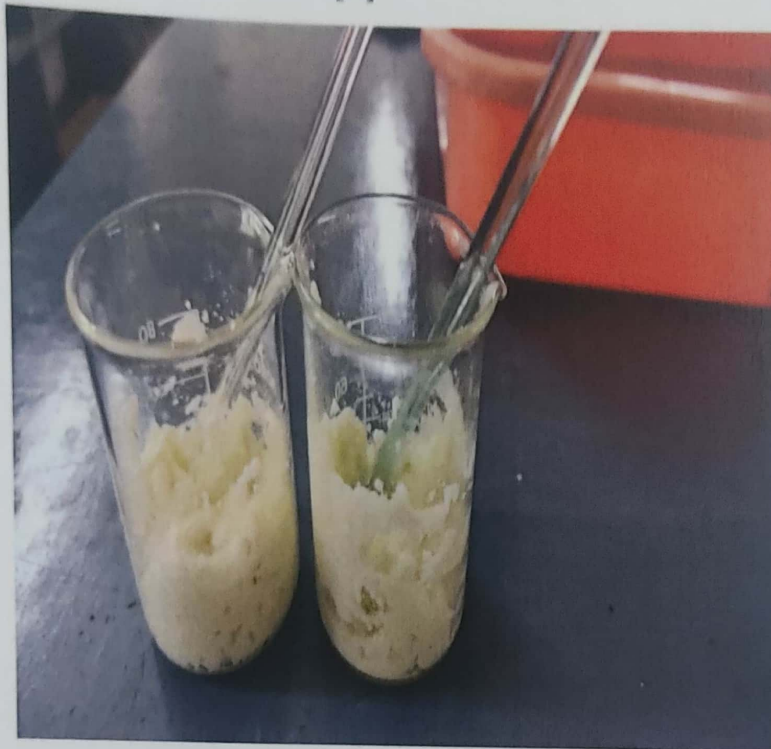
Calculation :

$$\text{Calcium, mg/l} = \frac{x \times 400.8}{\text{ml of sample}}$$

Where, x = volume of EDTA used.

- These compositions vary by breed, animal, and point of the lactation period.
- An analysis of the composition of the milk samples showed the difference in protein, (casein) and calcium content in different animals.

[A]



[B]

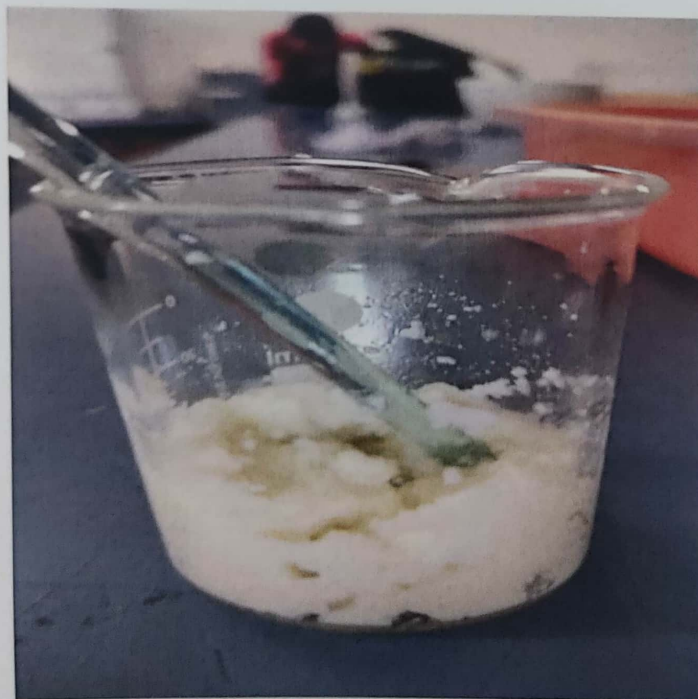


Fig 8: { A,B}: Casein Formation After Adding Acetic Acid and Boiling.

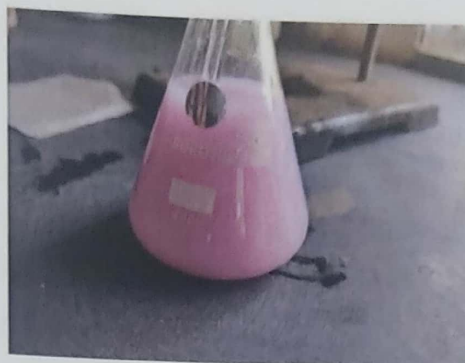


Fig 9: Estimation of Calcium from milk white to light pink colour after adding murexide indicator



Fig 10: Complexometric titration for calcium.



Fig 11: Colour change from light pink to purple it shows presence of calcium.

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Results

HERE ARE THE RESULTS OF THE COMPARATIVE STUDY OF PROTEIN AND CALCIUM CONTENT IN GOAT, COW BUFFALO AND PACKAGED MILK (AMUL, SHRINATH) (SAMPLE SIZE 100 ML)

PROTEIN (casein) Present in milk ; [100 ml sample]

- I. Goat milk ▶ 5.406gm
- II. Cow milk ▶ 3.766gm
- III. Buffalo milk ▶ 6.505gm
- IV. Amul milk ▶ 2.94gm
- V. Shrinath milk ▶ 3.45gm

CALCIUM present in milk ;[100 ml sample]

- I. Goat milk ▶ 50mg/L
- II. Cow milk ▶ 67mg/L
- III. Buffalo milk ▶ 82.96mg/L
- IV. Amul milk ▶ 56mg/L
- V. Shrinath milk ▶ 56.1mg/L

PROTEIN [Casein]:

These results indicate then casein protein content in each type of milk.

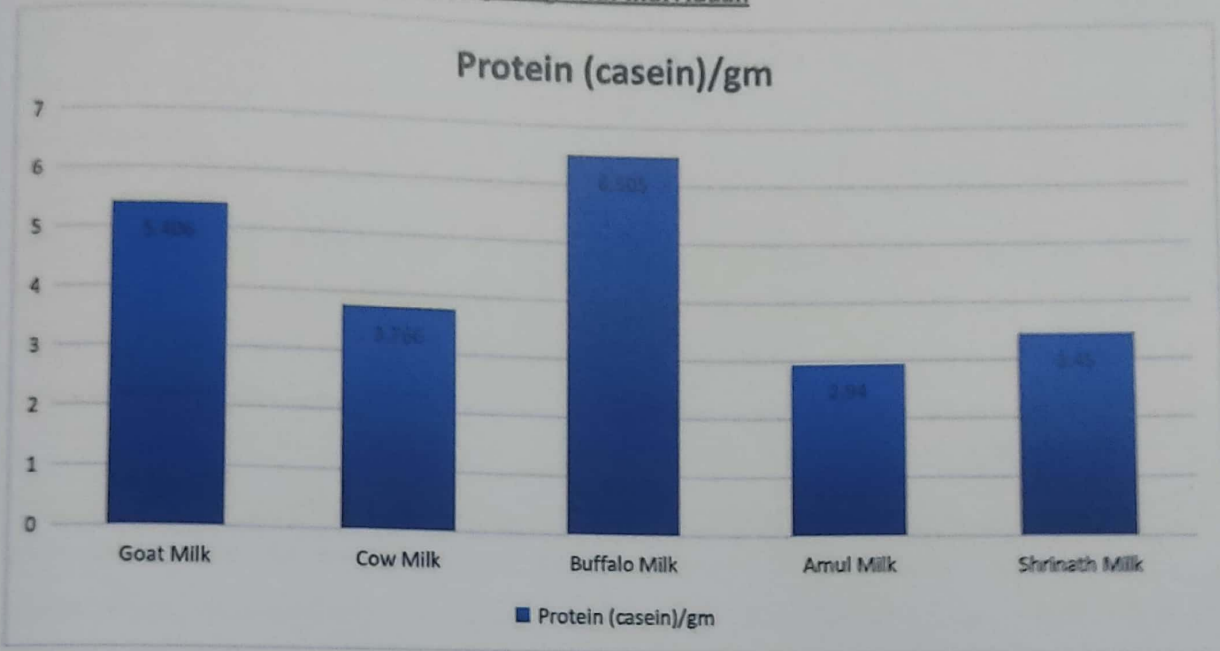
Buffalo milk has the highest protein content (6.505g), followed by Goat milk (5.406g), cow milk (3.766g), Shrinath milk (3.45g), and Amul milk (2.94g).

CALCIUM :

In terms of calcium content, Buffalo milk has the highest amount (82.96mg/L), followed by cow milk (67mg/L), Shrinath milk (56.1mg/L), Amul milk (56mg/L), and Goat milk (50mg/L).

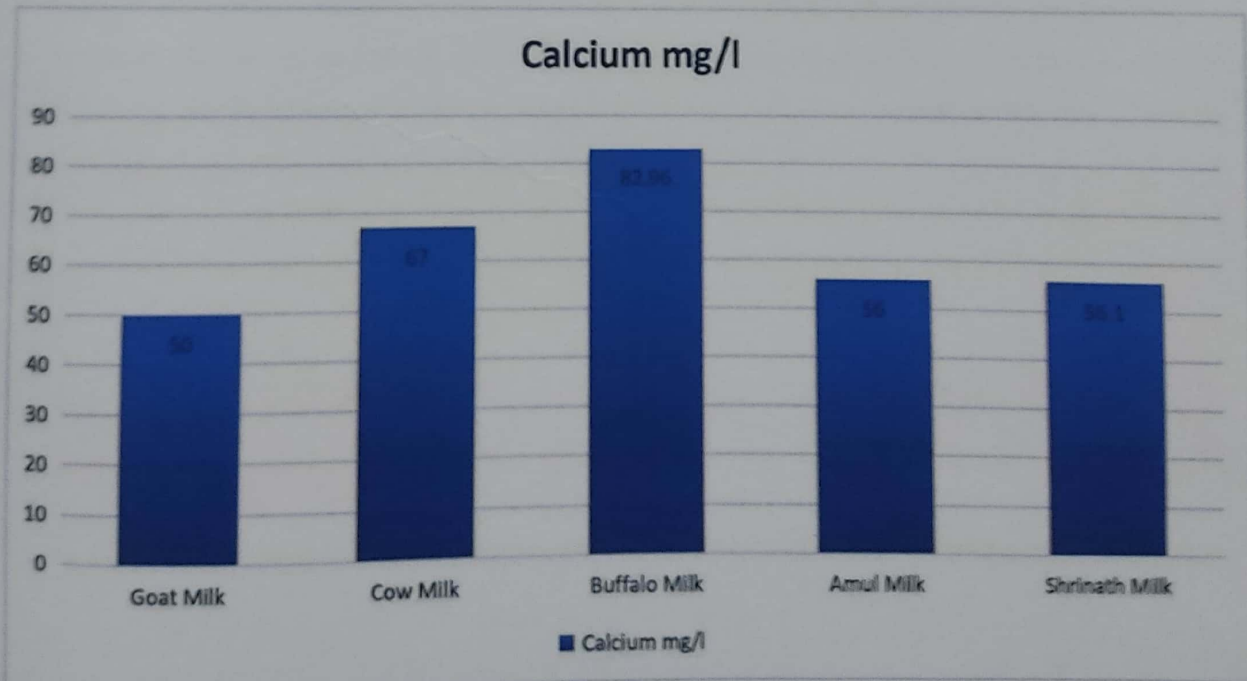
Graph 1:

Total Protein(casein) amount level comparing with individual.



Graph 2:

Total Calcium amount level comparing with individual.



Conclusion

In this comparative study, we investigated the protein and calcium content in different types of milk, including goat milk, cow milk, and buffalo milk, as well as two packaged milk brands, Amul and Shrinath. Our analysis revealed significant variations in the protein and calcium levels among these milk samples.

When comparing the protein content, we found that buffalo milk had the highest concentration, with an average of 6.505 grams per 100 milliliters, followed by goat milk with 5.406 grams and cow milk with 3.766 grams. Amul milk and Shrinath milk had the lowest protein content, with values of 2.94 grams and 3.45 grams, respectively.

Regarding the calcium content, buffalo milk exhibited the highest concentration, averaging at 82.96 milligrams per liter, followed by cow milk with 67 milligrams. Goat milk had the lowest calcium content among the natural milk samples, with an average of 50 milligrams per liter. Amul milk and Shrinath milk, the packaged milk brands, had similar calcium levels, with values of 56 milligrams per liter and 56.1 milligrams per liter, respectively.

Overall, the results indicate that buffalo milk possesses the highest protein and calcium content among the natural milk samples tested. However, it is worth noting that the protein and calcium content may vary based on various factors such as breed, animal diet, and environmental conditions. Additionally, the packaged milk brands, Amul and Shrinath, exhibited comparable levels of protein and calcium, suggesting similar nutritional profiles.

Discussion

The variations observed in protein and calcium content among different types of milk can be attributed to several factors. The protein content of milk primarily depends on the species and breed of the animal. For instance, goat milk is known to have higher protein levels compared to cow milk. This may be attributed to the difference in the casein protein composition and structure between goats and cows.

Furthermore, the animal's diet plays a crucial role in determining the nutritional composition of milk. The availability and quality of fodder, as well as the nutritional supplements provided, can impact the protein and calcium levels in milk. Different animals have varying dietary preferences and requirements, which can influence the nutrient content of their milk.

In the case of calcium, it is an essential mineral for bone health and plays a vital role in various physiological processes. Buffalo milk exhibited the highest calcium content, which could be attributed to the breed-specific variations and diet. Buffaloes are known to consume more calcium-rich fodder, resulting in higher calcium concentrations in their milk.

The packaged milk brands, Amul and Shrinath, showed similar protein and calcium levels, suggesting that they may have similar manufacturing processes and sourcing strategies. However, it is important to note that packaged milk undergoes various processing steps, such as pasteurization and homogenization, which can affect the nutrient composition.

It is important for consumers to consider the protein and calcium content when choosing milk based on their nutritional needs. Individuals with higher protein requirements or those seeking to increase their calcium intake may opt for buffalo milk, while those with specific dietary preferences or restrictions may choose goat milk. Packaged milk brands like Amul and Shrinath can be suitable alternatives for individuals looking for convenience and standardized nutrient content.

Further research could focus on analyzing the impact of factors such as breed, diet, and processing methods on the protein and calcium content of milk. Additionally, studying the bioavailability of these nutrients in different milk types can provide valuable insights into their potential health benefits.

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- Chemical and Biological method for water pollution studies By: R.K. Trivedy, and P.K. Goal
Publication : Environment publications ,Karad [IND]

**DIVERSITY OF INSECTS IN APTI (KHURD) VILLAGE OF
VIKRAMGAD TEHSIL, PALGHAR."**

A DISSERTATION SUBMITTED TO
THE UNIVERSITY OF MUMBAI

TOWARDS PARTIAL FULFILMENT OF

THE DEGREE OF

MASTER OF SCIENCE

IN

ZOOLOGY

SUBMITTED BY

MR. KUDU HARSHAL PUNDALIK PRATIBEA

UNDER THE GUIDANCE OF

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(M.Sc. ANIMAL PHYSIOLOGY 2022-2023)


STATEMENT BY THE CANDIDATE

As required by the University Final Year Research Project, I wish to state that the work embodied in this dissertation titled "Diversity of Insects in Aпти (Khurd) Village of Vikramgad Tehsil, Palghar" forms my own contribution to the research work carried out under the guidance of Dr. H. S. Vanmali at the Sonopant Dandekar Arts, V. S. Apte Commerce and M. H. Mehta Science College, Palghar. This work has not been submitted for any other degree of this or any other University. Whenever references have been made to previous works of others, it has been clearly indicated as such and included in the Bibliography


Signature of Candidate

Name: Mr. Harshal Pundalik Kudu

Certified By:

Signature of Guide

Name: Dr. Harshad Sharad Vanmali



CERTIFICATE

This is to certify that the dissertation Entitled "Diversity of Insects in Apti (Khurd) Village of Vikramgad Tehsil, Palghar" is bonafied record of the work carried out under my guidance and supervision and that no part thereof has been presented for any degree, diploma or similar title of any other university.

H/S
15/7/2023
DR. HARSHAB VANMALI
HEAD OF DEPARTMENT
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M. Jambak
15.7.2023.
EXTERNAL EXAMINER

15 JUL 2023

THIS DISSERTATION IS DEDICATED

TO

MY BELOVED FATHER

MR. PUNDALIK M. KUDU

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PREFACE

The insects belong to phylum Arthropoda which is the largest group of organisms surviving on the Earth under kingdom Animalia. Insects are an important part of ecosystem and have various essential roles in the nature. Insects benefit the humans in many ways and nature as well.

In this study I have choose the Aпти (Khurd) village which lies within geographic position of Latitude: 19° 41' 8.7072" N and Longitude: 73° 4' 37.3836" E. it is lying on the border of two tehsils Wada and Vikramgad in Palghar District, Maharashtra, India. The study area is divided into five different zones which will help to study the diversity of insects in a comparative approach.

There is no any kind of report which can states that anthropogenic activities don't disturb the nature and wildlife. Since last few years, there has been increase in industrial area of selected study area. Also, people of this village are now more into clearing lands for different purposes. This might affect the flora and fauna of this area and may disturb the ecological balance of the nature.

This study will assess the diversity and the distribution of insects in Aпти (Khurd) village of Vikramgad for the first time. Current study will help to understand the impact of human disturbances on insects' fauna and nature. My dissertation consists of total six chapters which are as follows:

➤ **Chapter I**

The chapter I includes the main summary of the topic i.e., Abstract along with the keywords.

➤ **Chapter II**

It has introduction to the topic, specified aim of the study and objectives with which study was initiated. Along with these, the rationale of the study is discussed.

➤ **Chapter III**

This chapter consists of literature review related to the topic which includes the overview of studies performed by other researchers.

➤ **Chapter IV**

It gives information about various materials and methods used for sampling of the insects. It also consists of the sources which are used for the identification of species.

➤ **Chapter V**

It consists of results obtained from data collection. These results are displayed in the form of tables, graphs, pictures, pie diagrams etc. It also consists of discussion on the obtained results.

➤ **Chapter VI**

It consists of drawn conclusions from the study followed by the Bibliography which includes all the cited references used for this study.

AKNOWLEDGEMENT

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Mr. Harshal Pundalik Kudu.

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Table 1: Inventory of species of insects from Apti (Khurd) Village.

Order	Family	Scientific Name	Common Name
Scolopedromorpha	Scolopedridae	<i>Rhysida longipes</i>	Minor Blue Leg
		<i>Rhysida nuda</i> <i>immarginata</i>	-
		<i>Cormocephalus sp.</i>	-
		<i>Scolopendra sp.</i>	-
Arachnida	Tetragnathidae	<i>Tetragnatha genus</i>	Long-Jawed Orb-Weavers
	Oxyopidae	<i>Oxyopes quadrifasciatus</i>	Orange Strip Lynx Spider
	Araneidae	<i>Larinioides sp</i>	Orb Weaver Spider
		<i>Araneus sp.</i>	Angulate Orb Weavers
	Anyphaenidae	<i>Anyphaena sp.</i>	Sac Spider
	Lycosidae	<i>Arctosa sp.</i>	Wolf Spider
Isoptera	Rhinotermitidae	<i>Coptotermes formosanus</i>	Formosan Sub-Terranean Termite
Isopoda	Philosciidae	<i>Philoscia muscorum</i>	Common Woodlouse
Orthoptera	Acrididae	<i>Oedipoda coerulea</i>	Iberian Band Winged
		<i>Pezotettix giorna</i>	Short Horn Grasshopper
		<i>Trilophidia sp.</i>	-
Odonta	Libellulidae	<i>Diplacodes trivialis</i>	Chalky Percher Skimmer
		<i>Trithemis arteriosa</i>	Red-Veined Dropwing
		<i>Acisoma panorpoides</i>	Asian Pintail
		<i>Brachythemis contaminate</i>	Ditch Jewel
		<i>Indothemis carnatica</i>	Black Marsh Skimmer
		<i>Crocothemis servilia</i>	Scarlet Skimmer

	Coenagrionidae	<i>Ceriagrion coromandelianum</i>	Coromandel Marsh Dart, Yellow Waxtail
	Platycnemididae	<i>Onychargia atrocyana</i>	Marsh Dancer
	Coenagrionidae	<i>Ischnura aurora</i>	Aurora Bluetail
Hemiptera	Flatidae	<i>Siphanta acuta</i>	Turpedo Bug
	Coreidae	<i>Acanthocephala terminalis</i>	Leaf-Footed Bug
	Miridae	<i>Stenoderma sp.</i>	Nearctic Plant Bug
		<i>Orthotylus sp.</i>	-
	Membracidae	<i>Centrotus cornutus</i>	Treehopper
Plataspidae	<i>Coptosoma xanthogramma</i>	Black Stink Bug	
Coleoptera	Coccinellidae	<i>Coccinella Transversalis</i>	Transverse Lady Beetle
		<i>Propylea quatuordecim punctata</i>	Spotted Laybird
	Chrysomelidae	<i>Altica oleracea</i>	Blue-Black Leaf Beetles
	Chrysomelidae	<i>Gonioctena viminalis</i>	Leaf Beetle
	Scarabaeidae	<i>Oryctes rhinoceros</i>	Asiatic Rhinoceros Beetle
	Cerambycidae	<i>Xystrocera globosa</i>	-
Lepidoptera	Nymphalidae	<i>Euploea core</i>	Common Crow
		<i>Danaus genutia</i>	Common Tiger
		<i>Tirumala limniace</i>	Blue Tiger
		<i>Mycalesis perseus,</i>	Common Bushbrown
		<i>Mycalesis mineus</i>	Dark-Band Bush Brown
		<i>Mycalesis nicotia</i>	Bright Eye Bushbrown
		<i>Mycalesis intermedia</i>	Intermediate Bush Brown
		<i>Mycalesis mineus polydecta</i>	Dakhan Dark Brand Bushbrown

		<i>Neptis hylas</i>	Common Sailer
		<i>Junonia iphita</i>	Chocolate Pansy
		<i>Junonia almanac</i>	Peacock Pansy
	Lycaenidae	<i>Hemiargus ceraunus</i>	Ceraunus Blue
		<i>Euchrysops cnejus</i>	Gram Blue
		<i>Castalius rosimon</i>	Common Pierrot
	Pieridae	<i>Delias eucharis</i>	Common Jezebel
		<i>Catopsilia pomona</i>	Common Emigrant
		<i>Eurema hecabe</i>	Common Grass Yellow
	Crambidae	<i>Spoladea recurvalis</i>	Hawaiian Beet Webworm
<i>Elophila nymphaeata,</i>		Brown China Mark	
Noctuidae	<i>Helicoverpa armigera</i>	Cotton Bollworm	
Diptera	Calliphoridae	<i>Chrysomya albiceps</i>	Blowfly
	Anthomyiidae	<i>Pegomya hyoscyami</i>	Beet Or Spinach Leafminer
	Syrphidae	<i>Paragus bicolour</i>	-
		<i>Melanostoma millineum</i>	Hoverfly
	Asilidae	<i>Promachus vertebrates</i>	Robberfly
	Bombyliidae	<i>Anthrax sp.</i>	Beefly
	Muscidae	<i>Musca domestica</i>	Housefly
Tipuloidae	<i>Tipula maxima</i>	Crane Fly	
Blattodea	Blattidae	<i>Periplaneta americana</i>	Ship Cockroach
	Ectobiidae	<i>Blattella germanica</i>	German Cockroach
Psocoptera	Liposcelididae	<i>Liposcelis sp.</i>	Booklice
Hymenoptera	Apidae	<i>Apis cerana indica</i>	Indian Honeybee
		<i>Apis florea</i>	Dwarf Honeybee
	Vespidae	<i>Vespa orientalis</i>	Oriental Hornet
		<i>Delta pyriforme</i>	Potter Wasp
	Formicinae	<i>Camponotus pennsylvanicus</i>	Black Carpenter Ant
		<i>Solenopsis sp.</i>	Fire Ant

Table 2: Orders of Sampled species of insects with representative organisms

Sr. No.	Order	Representative Organisms
1	Scolopedromorpha	Centipedes
2	Archanida	Spiders & Scorpions
3	Isopoda	Woodlice
4	Isoptera	Termites
5	Orthoptera	Grasshoppers, Crickets & Locusts
6	Odonta	Dragonflies & Damflies
7	Hemiptera	True Bugs
8	Coleoptera	Beetles
9	Lepidoptera	Butterflies & Moths
10	Dipetera	Flies
11	Blattodea	Cockroaches
12	Psocoptera	Booklice
13	Hymenoptera	Ants, Honeybees & Wasps

Table 3: Species Count with respect to Families and Orders in Aпти (Khurd).

Order		Family		Count	
Sr. No.		Sr. No.		Family	Order
1	Scolopedromorpha	1	Scolopedridae	4	4
2	Archanida	2	Tetragnathidae	1	6
		3	Oxyopidae	1	
		4	Araneidae	2	
		5	Anyphaenidae	1	
		6	Lycosidae	1	
3	Isopoda	7	Rhinotermidae	1	1
4	Isoptera	8	Philosciidae	1	1
5	Orthoptera	9	Acrididae	3	3
6	Odonta	10	Libellulidae	6	9
		11	Coenagrionidae	2	
		12	Platycnemididae	1	
7	Hemiptera	13	Flatidae	1	6
		14	Coreidae	1	
		15	Miridae	2	
		16	Membracidae	1	
		17	Plataspidae	1	
8	Coleoptera	18	Coccinellidae	2	6
		19	Chrysomelidae	2	
		20	Scarabaeidae	1	
		21	Cerambycidae	1	
9	Lepidoptera	22	Crambidae	2	20
		23	Lycaenidae	3	
		24	Noctuidae	1	
		25	Nymphalidae	11	
		26	Pieridae	3	
10	Dipetera	27	Calliphoridae	1	8
		28	Anthomyiidae	1	
		29	Syrphidae	2	
		30	Asilidae	1	
		31	Bombyliidae	1	
		32	Muscidae	1	
		33	Tipuloidae	1	
11	Blattodea	34	Blattidae	1	2
		35	Ectobiidae	1	
12	Psocoptera	36	Liposcelididae	1	1
13	Hymenoptera	37	Apidae	2	6
		38	Vespidae	2	
		39	Formicinae	2	

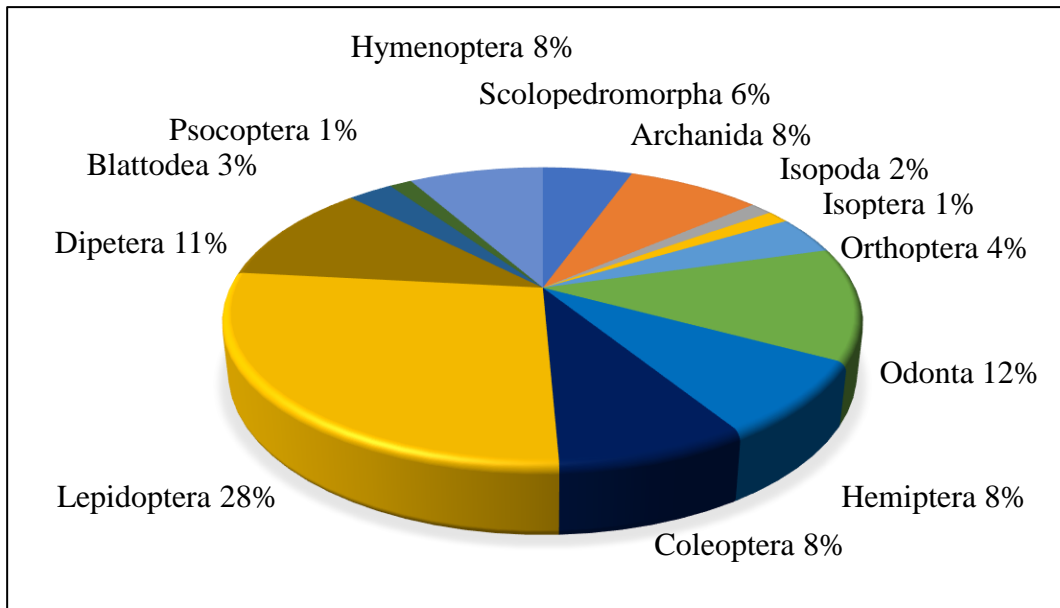


Figure 1: Order wise distribution of Insects in Aпти (Khurd) village.

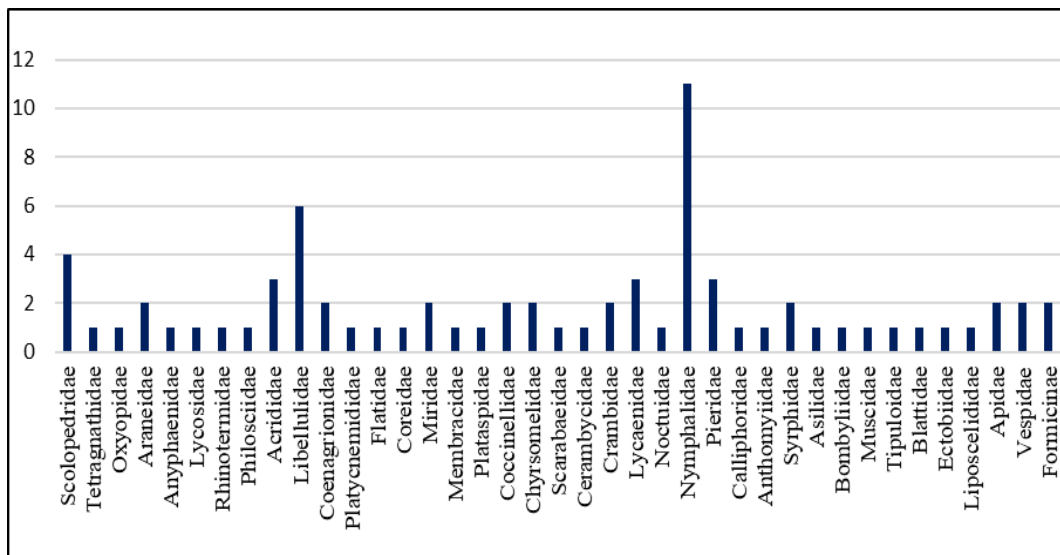


Figure 2: Family wise distribution of Insects in Aпти (Khurd) village.

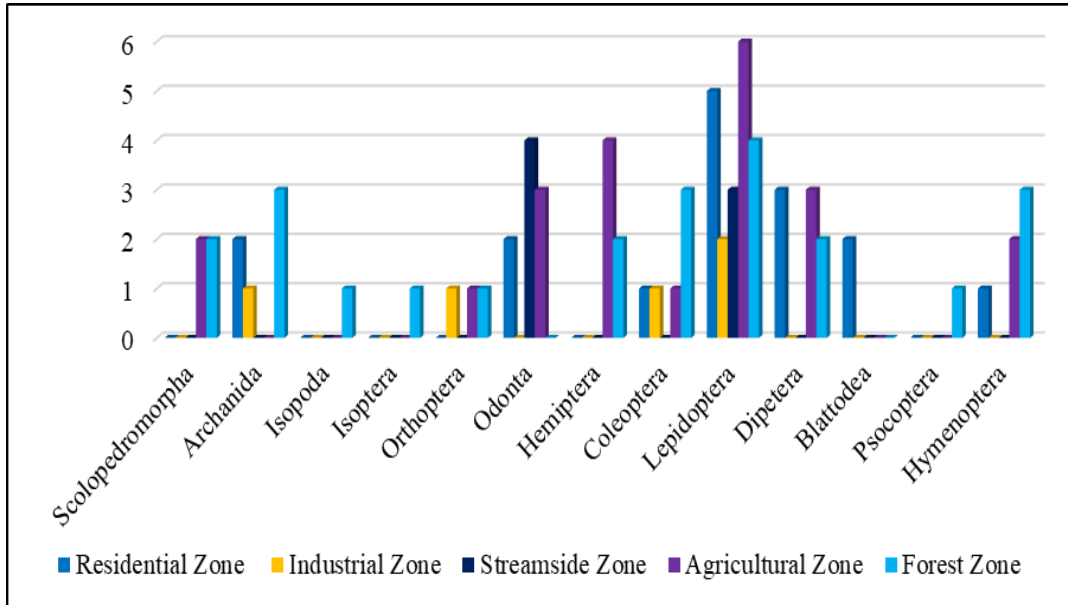


Figure 3: Zone wise distribution of Insects in Apti (Khurd) village.

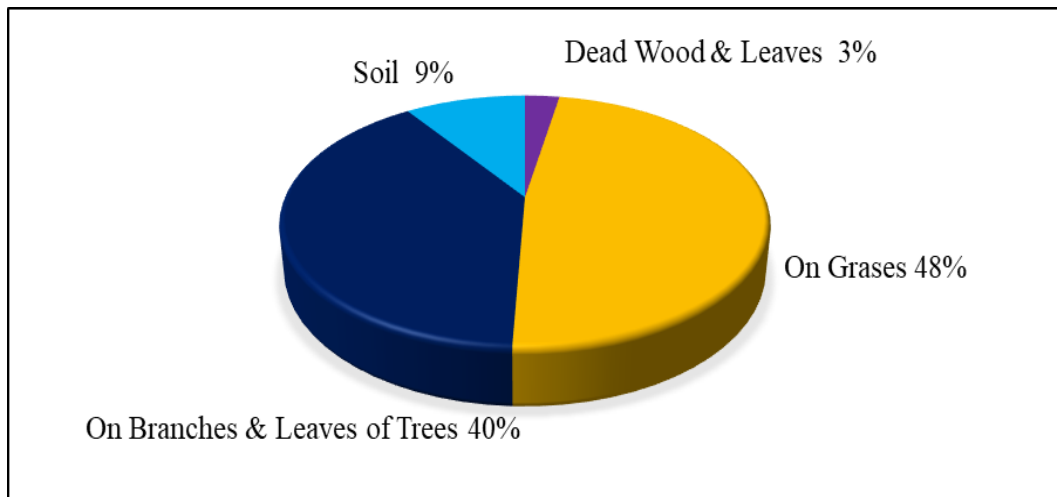


Figure 4: Habitat wise distribution of Insects in Apti (Khurd) village



Plate 1.1: Apti (Khurd) Village (Satellite View)



Plate 1.2: Apti (Khurd) Village



Plate 1.3: Selected Zones of Apti (Khurd) Village for Study
(Reference maps were taken from <https://www.google.com/maps>)

Plate 2: Photographs Gallery of Sampled species from Aпти (Khurd) Village.



Tetragnatha genus



Oxyopes quadrifasciatus



Larinioides sp



Araneus sp.



Arctosa sp.



Anyphaena sp



Philoscia muscorum



Oedipoda coerulea



Trilophidia sp



Coptotermes formosanus



Diplacodes trivialis



Trithemis arteriosa



Brachythemis contaminata



Ceriagrion coromandelianum



Onychargia atrociana



Ischnura aurora



Siphanta acuta



Acanthocephala terminalis



Stenoderma sp.



Orthotylus sp.



Centrotus cornutus



Coptosoma xanthogramma



Coccinella transversalis



Propylea quatuordecim punctata



Altica oleracea



Goniocтена viminalis



Xystrocera globosa



Mycalesis perseus



Neptis hylas



Junonia almana



Hemiargus ceraunus



Euchrysops cnejus



Castalius rosimon



Junonia iphita



Eurema hecabe



Spoladea recurvalis



*Elophila
nymphaeata*



*Chrysomya
albiceps*



*Pegomya
hyoscyami*



Melanostoma millineum



Promachus vertebratus



Anthrax sp.



Tipula maxima



Liposcelis sp



Delta pyriforme

CHAPTER I

ABSTRACT

CHAPTER I

ABSTRACT

The field survey was conducted at Aпти (Khurd) village located in Vikramgad Tehsil of Palghar District in Maharashtra, India. The study area was divided into five zones: Residential Zone, Agriculture Zone, Streamside Zone, Industrial Zone and Forest Zone. Insect's sampling was done per week from Mid of August to Mid of December, 2022; in morning hours. A total of 73 species of insects were sampled which belong to 13 Orders under 39 Families. Sampled insects were distributed on basis of order wise distribution, family wise distribution, zone wise distribution and habitat wise distribution. Order Lepidoptera (Butterflies, Moths) are capable of surviving in all zones & thus have adaptive features and thus dominant of all followed by Odonta (Dragonflies & Damflies). Fastly growing Industrial zone and other human anthropogenic activities can badly affect insect diversity and ultimately environment. Invertebrates are more sensitive and quickly affected by changes in the environment than any other taxa. Thus, a strong understanding of insect responses to human activity will be useful to evaluate functional consequences of human disturbance on ecosystems. This attempt will be useful to make aware the authorities specially town planners about rich heritage of this area and to plan scientifically and sustainably.

Keywords: Survey, Aпти (Khurd), Vikramgad, Palghar, Insects, Diversity.

CHAPTER II

INTRODUCTION, AIM AND OBJECTIVES AND RATIONALE

CHAPTER II

PART A

INTRODUCTION

Introduction

About 8.7 million of total number of species have been estimated to be surviving on the Earth and can range between 3 to 100 million species suggested by taxonomic experts (Mora *et al.*, 2011; May, 2010). Out of which insects are among the major surviving organisms and are found in almost each and every habitat thus, they are referred as omnipresent organisms. Insects belong to phylum Arthropoda which is one of the most prominent of all the phyla under kingdom Animalia. They contribute to 90% of the different animal life forms which actually exist on the planet Earth. (Huis *et al.*, 2013). Insects are the most diverse organisms on the earth, who represent almost 75% of the recorded fauna of the world.

Insects are the central players in most of the major biomes of the world except for the high polar regions and marine ecosystems. Especially they are found in tropics with an enormous richness of species and wide range of specializations. This is because of their special anatomical as well as physiological characteristics that they possess and that they have developed. They are having short life cycles and they possess higher powers of dispersal. Also, they have the ability to adapt with unfavourable conditions as well as the ability to evolve quickly by facing different ecological life challenges (Loxdale, 2016).

Insects are an important source of both ecosystem services and ecosystem disservices. They create the biological foundation for all terrestrial ecosystems. They help in the cycling of the nutrients; they help in maintaining the structure of soil and thus the fertility. Insects are considered as the important part of food chains in nature. Some species of insects act as predators while some species are the preys of other organisms (Eggleton, 2020).

Also, they have great utility in the field of medicine and forensics (Farook *et al.*, 2020). It deals primarily with determining the place, the time and the mode of death in homicide cases. For example, a moth larva recovered from a plant seed attached to a

blanket used in a rape or sexual assault may provide evidence linking the crime to a particular location. Sometimes entomological evidence is found as broken and fragmented insect parts in the clothing or personal belongings of the suspect or victim. It can be done by analyzing the insects that were collected from and around corpses (Hall, 2001; Byrd & Castner, 2010).

Many species of insects are highly beneficial as pollinators and seed dispersers. Insect pollination can enhance average crop yield between 18 and 71% depending on the crop. The honeybees are found to be the most significant pollinators among the all-insect's species (Bartomeus *et. al.*, 2014). The production or yield increases because of the pollinators for seeds of vegetatively propagated crops permits breeding progress and hybridization for the development of new varieties (Klein, 2007).

They are used as biological control agents to protect the crops from invasive insects' pests as well as the agriculturally based products. Social wasps are found to be the natural predators of many lepidopteran pests (Southon *et. al.*, 2019).

Insects are an important part of the traditional diets and also a rich source of the proteins. The Edible insects are rich in protein and amino acids, especially essential amino acids which are necessary for the human body. Also, they can supply unsaturated fatty acids, minerals, vitamins and carbohydrates which have an excellent nutritive value. (Halloran *et. al.*, 2014; Tiencheu and Womeni, 2017).

Recently there has been a drop in local insect's abundance, biomass, and species density. The main reasons of this decline are human disturbance (Cardoso *et. al.*, 2020), urbanization (Corcos, 2019), habitat destruction, conversion of natural ecosystems to agricultural ones, agricultural intensification (Raven, 2021) and increased use of pesticides (Sánchez-Bayo, 2021). Also a few less commonly considered factors include atmospheric nitrification from the burning of fossil fuels and the effects of droughts and changing precipitation patterns (Wagner, 2020).

The climate change is likely to make some species go locally extinct (Eggleton, 2020). Temperature is known for limiting the distribution, the rate of development, the number of generations and the population abundance of an insect species in a specific region. Climate changes have adverse effects on host plant resistance. It affects the natural enemies of insects as well as it can alter the properties of biopesticides and

synthetic chemicals used in pest management. Because of this, even the species of plants which are resistant to specific insects may also become susceptible (Sangle *et. al.*, 2015).

Pollution is another reason which severely affecting the population of the insects. Also, the common air pollutants such as nitrogen oxides (NO_x), emitted in diesel exhaust, and ozone (O₃), have been implicated in the decline of pollination. These pollutants are found to be reacting with floral odors (Ryalls *et. al.*, 2022).

Because of their high species diversity, a ubiquitous occurrence, and an importance in the functioning of natural ecosystems, insects can be used in environmental impact assessment. (Rosenberg, Danks, & Lehmkuhl, 1986). Also, insects are very sensitive to the environmental changes, so small disturbances in the environment can affect their life, can affect their population. This attempt will help to study and analyze the current degradation rate and its future consequences. It can also provide base for planning the conservation strategies for them.

The main aim of this study is to identify the insects' species and collect the data to know their diversity richness in different habitats, specifically the microhabitats in selected study area. This kind of study is designed for the very first time to document the diversity of insects in Vikramgad tehsil of Palghar district.

PART B
AIMS AND OBJECTIVES

Aim:

To study the diversity richness of insect species found in Aпти (Khurd) village of Vikramgad tehsil which comes under Palghar district.

Objectives:

1. To study the composition of insect's fauna at species level in selected study area.
2. To identify the different habitats of insects in which insects are found to be surviving.
3. To study the diversity and distribution of insects in those identified different habitats.
4. To study how biotic (Insects) and abiotic components (Environment) integrate with each other.

PART C
RATIONALE

In past few years, the number of local insects' species has been declined and still decreasing. One of the main reasons for this decline in number of insects and other species is the increased human disturbances. Insects are the invertebrates which are more sensitive and get quickly affected by disturbances in the environment than any other taxa. Thus, a strong understanding of insect responses to the human activity will be useful to assess the functional consequences of the human disturbances on the nature and the ecosystems.

This is also may be due to the conversion of the natural ecosystems to the agricultural ones, an agricultural intensification, increased use of pesticides in last few years, growing continuous urbanization, simply the clearing of lands for different purposes. The pollution is another major concern which severely affecting the population of the insects and their survival. Thus, insects can be used as agent in the environmental impact assessment.

Data collected from this study will be helpful to make aware the authorities such as the government bodies, the developmental organizations, the non-governmental organizations (NGOs) and especially, the town planners about faunal heritage of insects of this area. It will guide them especially, the town planners to plan sustainably, scientifically as well as to take necessary precautions while planning so that life of insects will not be affected. The data collected from this study will help in planning the conservation strategies for them. This will ultimately help for the protection of insect fauna of respective area.

Insects play a very important role in maintaining the balance of ecosystem. They are the predators as well as they are the preys thus, balancing the food chain. Also, some of the insects form the important part of diet. Edible insects are richer in proteins. At the same time, they are one of the most important pests threatening crops as well as stored products, attacking clothes and paper products. Some act as vectors transmitting the diseases humans as well as other organisms. Current study will provide the information that will assist all the stakeholders to identify beneficial species and also in managing the noxious species.

CHAPTER II
REVIEW OF LITERATURE

CHAPTER III

REVIEW OF LITERATURE

India is known for its glorified biodiversity richness which is due to abundance of the forest ecosystems, the riverine ecosystems and other geographical features. Because of multiple forms of habitats, the microhabitats; a diversification is seen among the living organisms and the insects are one of such examples. Insects are among the largest group of organisms surviving on the earth.

The insects are known to play the essential; role in the ecosystem such as balancing the food chain, as a part of traditional diet, as a major pollinators and other ecological roles. Because of these reasons insect have great importance in nature. So many studies have been reported which signify the insects' distribution pattern, their abundance, their diversity and other aspects.

Graham *et. al.*, (2021) has summarized Standards and Best Practices for Monitoring and Benchmarking Insects which includes insect sampling methods such as malaise trapping, light trapping, pan trapping, pitfall trappings, beating sheets, acoustic monitoring, and active visual surveys. Different Insect inventorying techniques were also discussed by Häuser and Riede (2015).

Various literatures are available for identification of insect species such as the Photographic Atlas of Entomology and Guide to Insect Identification by Castner (2004). Also, there are various internet portals which can help to identify the insects' species. India Biodiversity Portal (IBP) is one of them which is a repository of information on the biodiversity of the Indian subcontinent. Another such portal is iNaturalist which is a joint initiative of the California Academy of Sciences and the National Geographic Society.

A preliminary study was conducted by Joshi and Dahanukar (2012) in the Northern Western Ghats, India to study the diversity and distribution of centipedes (Scolopendromorpha: Chilo-poda) They reported 100 individuals from 22 species belonging Geophilomorpha, Scolopendromorpha and Scutigermomorpha orders. Also, the open scrub was found to be a more diverse habitat. Khanna (2006) has provided the checklist of Centipedes collected by the scientists of Central Regional Station, Zoological Survey of India, Jabalpur, Madhya Pradesh, from the Achanakmar-

Amarkantak Biosphere Reserve and adjoining areas in Chhatisgarh and Madhya Pradesh, including Panchmarhi Biosphere Reserve which represents 11 species of centipedes Scolopendromorpha.

A survey of spiders was carried out in a tropical reserve forest of Pohra Malkhed, Amravati in 120 species of Spiders belonging to 14 Families and 37 genera were sampled (Vairale and Wagh 2021). They have collected the data from five different Microhabitats viz. the grassland, the bush land, the woodland, the agricultural land and the wetlands.

Bhusnar (2015) has studied the Acridid (Orthoptera) diversity and they reported total 18 species from seven sub families from different tahsils of Solapur district. The maximum population of grasshoppers was found in Post monsoon period and minimum population in pre-monsoon period. It's because in the post monsoon period a relatively rich variety of vegetation is available.

Tiple and Koparde (2015) have compiled the data from field studies and from literature available which resulted in recording of 134 species of Odonata, including 87 species of Anisoptera and 47 species of Zygoptera from Maharashtra. The Libellulidae (48 species) family has the highest numbers of species which is followed by the Gomphidae (22 species) family.

The taxonomic survey and collection of the heteropteran bugs were carried out from Nashik during the year 2013-2014 by Tidame (2016) which revealed a total of 15 species belonging to 14 genera were recorded.

Wankhade, Manwar & Malu (2014) had conducted a preliminary Study on Diversity of Order Coleoptera in Amravati, Maharashtra. This study has revealed 27 beetle species of beetles A similar kind of study on Diversity of Coleopteran beetles was performed by Gurule et. al. (2020). They reported a total of 37 species from 33 genera belonging to 10 families from Nashik City, Maharashtra.

Patil *et. al.*, (2017) performed the investigation at Rawanwadi reservoir, Bhandara, Maharashtra between April 2015 to March 2016 and reported a total of 84 species belonging to 5 families and 54 genera of Lepidoptera. Abundance of host and larval food plants and vegetation due to forest results in a higher number of species of butterflies in selected study area.

Family-level diversity of Diptera was studied in the Mumbai Metropolitan Region (MMR) by Dhamorikar (2017). He recorded 50 families in total four protected areas- Sanjay Gandhi National Park, Tungreshwar Wildlife Sanctuary, Karnala Bird Sanctuary, and Matheran Eco-Sensitive Zone.

Mamlayya & Gaikwad (2010) studied Diversity of hymenoptera in Amba reserved forest of Kolhapur district, Western ghats, Maharashtra, India. Study revealed that 82 species were distributed over 47 genera belonging to 17 families. This number is prominent due to healthy climatic conditions and availability of natural resources in the study area which are necessary for life processes and existence of hymenopterans

In last few years, a drop has been reported in their population which is matter of concern, so many researchers are now studying the insects for finding out the answers of these newly raised questions.

Jaganmohan *et. al.*, (2013) reported that there is a decline in number of insects in domestic gardens when subjected to pesticides. Also, pesticides and herbicides can cause severe health concerns. Now a days most of farmers use the insecticides in agriculture for preventing the crops from pests but these insecticides can eliminate the other insects as well from the ecosystem.

Prakhar *et. al.*, (2021) studied the insect diversity in different habitats found in nearby locality of Raipur, Chhattisgarh. The total 603 species were sampled which belong to 38 families and 10 orders. Diptera was identified with maximum number of species i.e.,153. Since this area have good vegetation as Kharif and Rabi crops grown by the farmers and because of abundance of host plant and animals are in the urban area, insects were prominent and diverse in this area.

Another study supporting this view that vegetation and insects' diversity go hand in hand is a study which was conducted in Western Satpuda region by Mahajan and Patil (2014). They found total 443 insect species belonging to 102 families and 19 orders. The plant diversity was also conducted at the same time which reveals that the plant diversity is important in shaping the insect species diversity. Insects were also classified on the basis of range of their modes of feeding: Phytophagous (Highest, 159), Predators, Nectar feeders, Omnivorous, Detritus, Pollen feeders, Nectar and Pollen feeders and Sanguivores.

Jana, Misra & Bhattacharya (2006) has studied the industrial region of Haldia, West Bengal and the non-industrial area of the same region for finding out the relationship between the industrialization and the biodiversity of insects. They found out that even if favourable ecological conditions are available in a particular area, the richness of the species may drastically change with reference to the industries because of the pollution. They observed at least 23.33% decline in total insect fauna in industrial areas as compared to nonindustrial area. It is also found that some species of lepidopteran, hemipteran and orthopteran insects are more susceptible to the industrial pollution while, some of the members of these orders may be considered as a bioindicator group.

James *et. al.*, (2022) reported that the anthropogenic air pollutants such as nitrogen oxides (NO_x) emitted in diesel exhaust and ozone (O₃) has reduced the counts of locally-occurring wild and managed insect pollinators by 62-70% as well as their flower visits by 83-90%, specifically the bees, the flies, the moths and the butterflies which are the major pollinators.

The patterns of Insect Abundance and Distribution in Urban Domestic Gardens of Bangalore, India was studied by Jaganmohan *et. al.*, in 2013. They recorded over 2,000 insects from 10 orders in the selected gardens of 50 houses. They found that the number of insect orders appears to increase as the number of species of trees, herbs and shrubs increases in one's domestic garden. Thus, practicing the domestic gardening even in the urban areas will help in supporting the insect survival and increase in their diversity richness.

CHAPTER IV
MATERIALS AND METHODS

CHAPTER IV

MATERIALS AND METHODS

Study Area

Apti (Kh) is a small beautiful village located in the Vikramgad tehsil of Palghar district in Maharashtra (Plate No. 1.1 and 1.2). Lying on border of Wada and Vikramgad Tehsils, it is situated about 41 km to the East side of the Palghar. This village is loaded with lush green forest from all sides. Apti (Kh) is located between Geographic position of Latitude: 19° 41' 8.7072" N and Longitude: 73° 4' 37.3836" E. The Elevation from the sea level is about 46m. The Corridor of Wada- Vikramgad passes through the middle of this town. The agriculture is the prominent practice followed by people living here. Also, an industrial area has been grown in this area in past 5-10 years. Since it is embedded in green forest, this village may have wide diversity of insect fauna.

Methodology

The field survey was conducted at Apti (Kh) located in Vikramgad Tehsil of newly formed Palghar District in Maharashtra, India. The study area was divided into five different zones on the basis of vegetation and other factors: the Agriculture Zone, the Forest Zone, the Industrial Zone, the Residential Zone and the Streamside Zone (Plate No. 1.3). These selected sites were approximately 200m away from center of the study village.

Sampling of the insects' species was done weekly from the Mid of August to the Mid of December, 2022 to know the diversity of insects in Apti (Kh). It was done in and around between morning (07:30-10:00) hours as well as in evening (15:00-17:30) hours.

The beating or sweeping of shrubs with the help of stick was done using long stick and a cloth was used to collect the insects falling on the ground. This method is followed 5-6 times per plant. Most of the species were captured by using insect nets to catch them, especially the flying insects (Graham, Michael, Rob and Morgan, 2021; Hauser and Riede, 2015). Some of the species were handpicked from the ground with the help of large forceps.

All the collected species were captured in photographs by using Canon EOS 700D DSLR Camera. After taking the photographs, insects were returned to their respective natural habitats from where they have been collected. The proper shoes, the full sleeves cloths, the hand gloves and the masks were used while sampling to avoid any health consequences.

Identification

Sampled species were identified with the help of available Standard Databases, and the Entomology Books. Also, the citizen science internet portals such as iNaturalist, India Biodiversity, etc. were used for identification (Bharti *et.al.*, 2016), (Bhattacharyya and *et.al.*, 2017), (Dhamorikar, 2017), (Joshi and Dahanukar, 2012), (Khanna, 2006), (Kishor *et al.*, 2017), (Komal *et. al.*, 2021) (Subramanian, 2018), (Suganya and Gunasekaran, 2020), (Tikader, 1987).

CHAPTER IV
RESULTS AND DISCUSSION

CHAPTER V

PART A

RESULTS

Insect Fauna of Apti (Khurd) Village:

73 different species of insects were sampled from the study area during the survey. These species belong to 13 distinct Orders and come under to 39 different Families. These 73 species of insects along with their Orders, Families, Genera and Common names are mentioned in Table No. 1.

Sampled insects were distributed on the basis of following criteria:

1. Order Wise Distribution of Species
2. Family Wise Distribution of Insects
3. Zones Wise Distribution of Insects
4. Habitat Wise Distribution of Insects

Order Wise Distribution of Species

Figure No. 1 shows the Order wise distribution of insects in Apti (Khurd) Village, Palghar. Among all the orders of sampled insects, the Lepidoptera (Butterflies and Moths) was found to be prominent of all. The Odonta occupy the second position. Total 20 species of the order Lepidoptera and 9 species of the order Odonta were sampled from the study area. The Order Isoptera and the Order Isopoda both stand on the last position. Table No. 2 represents identified orders of insects with their representative organisms.

Family Wise Distribution of Insects

The Family wise distribution of insects in Apti (Khurd) Village, Palghar is represented in Figure No. 2. Total 39 different families were sampled during the survey. The Nymphalidae family of order Lepidoptera (Butterflies and Moths) was prominent among all while the Libellulidae family of order Odonta (Dragonflies and Dam Flies) holds the second position. Table No. 3 highlights the Order wise Count as well as the Family wise Count of the sampled species.

Zones Wise Distribution of Insects

Members of the order Scolopedromorpha (Centipedes) preferred deep forest zones. Two species were also sampled from the residential area. Centipedes generally preferred solaced area. Species of Orb Weaver spiders were spotted in forest zone. Other species of Spiders (Order Archanida) were also seen in other zones. Isopterans (White ants or Termites) and Isopoda (Woodlice) were found only in forest area under the fallen big branches of the trees. Surprisingly, the Orthopterans (Grasshoppers) were spotted around the industrial area. Along with that, they were also spotted in rest of the zones as well, except for the residential and the streamside zones. Dam flies and dragonflies (Odonatans) were prominent near the streamside zone and the agriculture zone. Some species of insects were also spotted in the residential zone. The Hemipterans (Bugs) preferred the agricultural zone and the forest zone. The Coleopterans (Beetles) were found in all zones except for the streamside zones. The Lepidopterans (Butterflies and Moths) inhabit all types of zones. Lot of caterpillars of were sampled during this study work, but unable to identify them, because of unavailability of knowledge and data. The Dipterans (Flies) were found mostly in the residential zone and the agricultural zone. The Hymenopterans were prominent mostly in forest zone rather than all other zones. Agricultural zone also well suited for bees and wasps. One species of order Psocoptera also has been sampled. Figure No. 3 shows the Zone wise distribution of insects in Apti (Khurd) Village, Palghar.

Habitat Wise Distribution of Insects

Insects were found to survive on the grasses as well as on the trees. They were found staying or hanging on leaves and under the bark also. Some insects live inside the soil & even under dead wood & dead leaves. Different types of Grasses were the major habitat of insects. The Habitat wise distribution of insects in Apti (Khurd) Village, Palghar is represented in Figure No. 4.

PART B

DISCUSSION

Diversity depends upon Vegetation of that area. Specific insect needs specific type of host plant for their survival (Prakhar, Singh and Agrawal, 2021; Zhu, Peng and Wang, 2008). Industrial zone of study area had less vegetation as compare to all other zones, so only few species were found to be surviving in that area. In Agricultural zone, a smaller number of species were observed. As only one type of crop (monotonous crop farming) is cultivated in this area, so only few specific insects were found on these crops. Residential zone also showed limited kind of vegetation as well, specifically most of vegetation were covered by flowering plants, so again specific species of insects such as bees, beetles were spotted in this zone. Streamside zone had good level of vegetation; thus, different types of insects were spotted there. Specifically, the Odonatans were prominent in this zone. Thus, the which kind of vegetation would be beneficial for the survival of which kind species of insects can be understood through this study work.

The Pollution is one of the major factors which affect diversity of the insects. It causes decline in diversity of species (Kozlov, 2022). Luckily selected area had industrial zone which helped for doing comparative analysis. Very few numbers of species of insects were spotted in and surrounding area of industries, which shows that somewhat pollution affect the insects' survival. The insect fauna was also found to be 23.33% lower in the industrial areas in a study conducted in West Bengal (Jana *et. al.*, 2006). Surprising to know that moths (Lepidoptera) and grasshoppers (Orthoptera) were also observed near industrial zone which show that they might have developed some sort of adaptations. Rest of the zones had limited level of pollution; thus, insects were prominent in other zones. At what level pollution can affect the insects and ultimately the humans can be estimated through this work.

Odonatans were prominent in the streamside zone. Major reason for their high numbers that they lay their eggs in water and larvae of odonatans complete their life cycle inside water. For laying purpose, they prefer water source. Odonatans are considered to be good indicators of environmental health and water quality as well (De Moor, 2017). Also, Dragonflies are the predators of mosquitoes (Vatandoost, 2021). They feed on the eggs of mosquitoes and other vectors which are capable of causing

different diseases to humans as well as other animals. So, they play important role in control of mosquitoes ultimately disease.

Many times, even after spraying of insecticides, the crops get damaged off as well as the beneficial microorganisms. Also, a lot of insecticides level can alter soil fertility as well as can harm organisms surviving in soil (Aktar, Sengupta and Chowdhury, 2009; Damalas and Eleftherohorinos, 2011; Gunstone *et. al.*, 2021). The reason behind this is probably using wrong type of insecticide. Through such study work, which kind of pest is actually infecting the crop can be identified and according that insecticides can be applied.

Lepidopterans (Butterflies and Moths) were capable of surviving in all selected study zones which indicate that they are well adapted for all types of environmental conditions and other aspects. They might have developed some adaptations which are helping them for their survival even in the industrial zone. It will be very interesting to know that how they are facing all these conditions and how they are surviving in the further studies.

Hymenopterans especially the Honeybees helps in Pollination which involves the transferring of pollen grains (Khalifa *et. al.*, 2021). Pollination is one of the most important phases of sexual reproduction in the plants. It is essential for formation of new species, new varieties of plants by cross fertilization.

Out of four identified habitats, different types of Grasses were found to be the major habitat preferred by insects' species. This is again because of abundance of the vegetation. The Grasses are the most preferred host plants of different species of insects such as bugs, spiders, beetles, etc.

CHAPTER VI
CONCLUSION AND BIBLOGRAPHY

CHAPTER VI

PART A

CONCLUSION

This kind of work was done for the very first time in Vikramgad Tehsil to find out the biodiversity of insects. This study shows that the selected study area i.e., Aпти (Khurd) is rich in diversity.

Pollution is identified as major concern influencing the survival of insects. Along with the pollution, the loss of vegetation can affect the survival as well as the distribution of insects. A clearing of land for different purposes especially due to Anthropogenic activities will badly affect the insects' diversity and ultimately the environment.

An Apiculture can be practice in this village as two honeybee's species are sampled with abundance. They are sampled at multiple locations throughout the study area. Also, this village having a good level of vegetation specially the flowering plants which can serve as nectar sources for the honeybees. This will provide the job opportunities to the local people and thus, can boost the economic growth of the village, ultimately the district.

This attempt will be useful to make aware the authorities such as the government bodies, the developmental organizations and specially, the town planners about rich heritage of this area. It will provide guidance especially to the town planners to plan sustainably and scientifically with proper necessary precautions so that it will not cause any harm to insects' fauna.

Proper awareness regarding the importance of insects and their essential role in the ecosystem to the local peoples as well as to the industrial owners through the different programs and platforms should be encouraged. This will ultimately help for the protection of insect fauna of this area. This information will assist all stakeholders to identify beneficial species and also managing noxious ones.

PART B

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