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RESEARCH AND REVIEWS IN ANIMAL SCIENCE VOLUME II

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Research and Reviews in Animal Science Volume II

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PREFACE

In the ever-evolving tapestry of scientific inquiry, the field of Animal Science stands as a cornerstone, where the intricacies of the animal kingdom are explored, understood, and celebrated. As we embark on this journey through the pages of "Research and Reviews in Animal Science," we are poised to delve into a realm where curiosity meets discovery, where questions find their answers, and where the pulse of innovation beats vibrantly.

This compendium represents not just a collection of scholarly works, but a testament to the collective efforts of passionate researchers, scholars, and practitioners who dedicate their intellect and expertise to unraveling the mysteries that surround the diverse species with which we share our planet. Within these pages, readers will encounter a rich tapestry of studies, analyses, and insights that span the breadth and depth of Animal Science.

From the intricacies of animal behavior to the dynamics of livestock production systems, from the exploration of nutritional needs to the pursuit of sustainable practices, the topics encapsulated within this volume are as diverse as the creatures they seek to understand. Each chapter represents a thread in the fabric of knowledge, woven together to form a comprehensive mosaic of understanding.

As we navigate the terrain of contemporary research and review in Animal Science, it is imperative to acknowledge the tireless efforts of the contributors whose dedication fuels the advancement of our understanding. Their commitment to excellence, coupled with their relentless pursuit of truth, serves as a guiding light illuminating the path toward scientific enlightenment.

Moreover, in an era marked by unprecedented global challenges, the insights contained within these pages hold profound implications for the well-being of both animals and humans alike. Whether addressing issues of animal welfare, public health, or environmental sustainability, the research delineated herein serves as a catalyst for positive change, inspiring action and advocacy in pursuit of a more harmonious coexistence with the natural world.

As we embark on this intellectual odyssey, I extend my deepest gratitude to the authors, editors, and reviewers whose contributions have shaped this volume into a beacon of knowledge and discovery. May the insights contained within these pages spark curiosity, provoke contemplation, and inspire a renewed commitment to the pursuit of truth.

With anticipation and reverence for the boundless wonders of the animal kingdom, let us embark upon this voyage of exploration, guided by the spirit of inquiry and the pursuit of enlightenment.

Editors

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INTERCONNECTING ANIMAL RESPONSE TO ENVIRONMENTAL STRESS

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Abstract:

Many a time animals can not adjust to their environment, and react to maintain homeostasis, this reflex reaction is known as stress. Several unwanted processes happen in response to stress which can cause discomfort or even death. Abiotic stressors stimulate various biological and behavioural responses and ultimately unbalance homeostasis. Animals raise a number of mechanisms for adaptation which can be advantageous or disadvantageous. Sometimes environmental stress leads to higher levels of struggle and animals suffer various abnormalities. Several mechanisms in response to stress are well known like freezing, desiccation, intense heat, irradiation, and low-oxygen conditions (hypoxia). This chapter is an attempt to explore the interconnections of response to environmental stress.

Keywords: Stress, Adaptation, Natural Pressure, Homeostasis.

Introduction:

Environmental stress refers to a negative subjective psychological response to an environmental stimulus [1]. It is crucial to remember that an environmental stimulus that causes stress in one person in a given circumstance might not cause stress in another, or even in the same individual, in a different circumstance. Environmental stress is therefore a result of a person's engagement with outside stimuli. Studies on environmental stress have been conducted in a variety of indoor, outdoor, and virtual contexts, including homes and workplaces. It has been investigated both in the field and in the lab, and it has been a significant topic of study for many years, continuing to this day [1].

Any physiological reaction to stimuli internal or external that threatens the normal physiological equilibrium of a living animal is known as stress [1]. In ecology, "stress" refers to any internal state that an organism experiences when it is displaced from its primary ecological niche, which can be described in terms of gene expression profiles under normal or optimal operating conditions. This definition defines stress as an occurrence that occurs to organisms; if the organisms are unable to escape their surroundings, then stress is typically unavoidable and must be tolerated [1]. Instead, environmental stress seems to be essential for maintaining

individual integrity and many of the micro ways that population structures and biodiversity are expressed. It has also been important for the evolution of life below the catastrophic or mutation threshold [2].

Regular habitats have forever been threatening to organic entities. Openness to climatic pressure is standard in nature, and hydrological changes, particularly dry season and flood are vital. These effects can be made worse by human intervention. Thus, the natural pressure is famously connected with population decline and eradication; consequently, it's possible certain jobs in forming networks and setting off advancement are frequently disregarded, and whenever considered, they are in many cases still quality focused. Be that as it may, obviously underneath the change edge and, surprisingly, beneath the epigenetically set legacy of procured properties, natural anxieties are fundamental main thrusts in biological systems that empower life, especially in fluctuating [1]. At a significantly more essential level, ecological stressors have been despite everything vital participants in moulding organismal development. As such, moderate pressure assumes a significant part in working with neighborhood transformation by empowering better changes, synchronization, and working of numerous organismal frameworks. Then again, reaction to an intense and new stressor blocks typical organismal capabilities, and the significant expense of pressure resilience or absence of developed pressure reaction methodologies prompts transformative balance [2].

The assertion above by Darwin can currently be tracked down on the second page of the starting part of his On the Beginning of Species through Normal Determination and communicates his view that, even though the transformation of people to their regular physical and biotic climate is focal in his hypothesis of advancement, he felt that this was principally represented through intra and interspecific rivalry. To Darwin, the contest between 'natural creatures' was undeniably more critical than transformation to ecological circumstances [3-4].

Stress and ecological pressure:

Ecological pressure and the degree of stress forced must be characterized as comparable to the life form or population encountering this specific pressure. As a rule, we anticipate that life forms and populations be the most un-pushed in the climate they experience more often than not, and to turn out to be progressively worried when they experience conditions, that are stranger to them. This suggests that organisms and populations are more likely to be able to adapt to daily and seasonal fluctuations in temperature that are encountered regularly than to temperatures that are more extreme but only occasionally occur [1].

Albeit the term pressure is most frequently used to demonstrate either the ecological or the natural part, obviously according to a developmental viewpoint ecological strain and organic

reaction ought to be thought of as integrative. This suggests that changes in the degree of stress experienced by creatures or populations can be an outcome of changes in either the stressor or the focus [4]. Numerous definitions think about pressure in a physiological setting: the physiological reactions of people to natural burdens that influence their exhibition and prosperity. According to the point of view of the commitments on pressure-related research in this issue, we are more worried about characterizing pressure in a developmental setting. Evolutionary definitions ought to take into account both the stressor and the stressed, as was mentioned earlier because stress should be considered concerning both [2].

All of these definitions emphasize that the environmental factor reduces the organism's or population's fitness. To conquer such wellness decreases, creatures and populations can answer phenotypically or hereditarily and advance versatile components to lessen the inconvenient effect of the pressure [4]. This is the sort of definition that creators of the accompanying commitments have had as a main priority while intending to comprehend the effect of weight on the natural framework and versatile systems that might be the consequence of this [3].

It ought to be noticed that overall definitions that characterize pressure basically as a decrease in wellness' would imply that any decrease in wellness, whether little or enormous, would be viewed as unpleasant. As brought up by Hoffmann and Parsons (1991) this would suggest that in the wild most life forms and populaces would encounter pressure constantly, as the ecological circumstances would digress from ideal more often than not, and, subsequently, the greatest wellness is rarely achieved [5]. Numerous researchers, accordingly, favor the term pressure to be applied when the power of the pressure arrives at levels that possibly limit endurance or generation radically, subsequently imperiling the presence of life forms and population. Nonetheless, as the power of pressure frequently shifts at a consistent scale, and as a matter of fact the force can frequently be judged just deduced, it is challenging to choose past what level of force it ought to be called pressure instead of 'regular' variety of the natural circumstances [1].

Mechanisms against environmental stress:

Organisms need to be able to adapt to changes in their surroundings to survive. Cell stress, disturbed homeostasis, and accumulated cellular damage resulting from modified external parameters or internal variables placing different demands on cells are frequently experienced as a result of these changes. To withstand this stress, cells have developed ways to recognize harm and homeostatic imbalance, as well as ways to implement mechanisms that both correct the imbalance and help the organism adjust to its new surroundings. Cellular stress responses are the term used to describe these detection/reaction systems [1]. These are routes that react to

homeostatic imbalance brought on by many sources of cellular stress both independently and in concert, acting in various cellular compartments. They can often identify and react to the presence of misfolded proteins, which are typically brought on by stressors such as changes in temperature and the presence of foreign substances. Nevertheless, other types of homeostatic imbalance, such as lipid disturbance, can also trigger stress reactions. Furthermore, stress response systems have constitutive roles in the cell even in the absence of external stress and can be active under baseline conditions [3].

Freezing is a fear response that can be seen in response to situations or stimuli that are either conditioned or unconditioned. It appears as a range of species-specific defensive reactions; certain species have a high natural predilection for freezing, while other species virtually never use it as a defensive mechanism [6]. Defensive behaviour is shaped by a combination of environmental, trait, and state factors. When it comes to environmental considerations, the presence of escape routes and the distance from the predator are crucial in determining whether or not a species will freeze. Compared to proximal threats, distal threat causes longer freezing reactions. When there are escape routes available, freezing times are shorter and the likelihood of fleeing is higher than when there are no escape routes [3].

The stress response in animals is made up of a collection of physiological processes intended to restore homeostasis since stress arises when an animal's homeostasis is upset [7-8]. This reaction is linked to two different systems, the sympathetic adrenomedullary (SAM) axis, and the HPA axis, which are responsible for the first perception of the stressor [9-10]. Overall, long-term (chronic) responses entail a significant adjustment of neuroendocrine, immune, and metabolic responses to the stressor in the brain, whereas both central and peripheral activation involve the coordinated interplay of short-term (acute) behavioural and endocrine responses that prime animals for an instantaneous response to environmental adjustment [11].

The animal world remains severely threatened by biotic and abiotic stressors [12]. Stressful circumstances have led to the evolution of a vast array of defense mechanisms in both plants and animals that aid in surviving in unfavourable conditions. Effective crop breeding and animal husbandry need simultaneous regulation of several genes with fine specificity because abiotic stress typically involves multiple gene responses that co-ordinately regulate metabolic pathways to enable the organism to adapt to the stressful environment [13].

Although the discipline of studying the relationship between stress hormones and immune functions is still in its infancy, research in this area is essential to improving our understanding of how wild animals cope with sickness, particularly in light of the growing changes that humans are making to the biosphere [14]. Indeed, a variety of factors, including

pollution exposure, the introduction of non-native species, altered habitats, particularly urbanization, and climate change, have the capacity to modify stress reactions and induce disease [15]. The adrenal-derived glucocorticoid hormones, corticosterone in amphibians, reptiles, and birds, and cortisol in fish and many mammals are the first line of defense against stress in vertebrates [16]. When an environmental stressor triggers the production of these molecules, they promote gluconeogenesis, inhibit reproductive processes, change food and activity patterns, affect immunological responses, and generally assist a person in going into a "state of emergency [17]."

Sometimes, thirst tolerance is thought of as essentially a cellular survival tactic [18]. While individual cells must produce the defenses they need to survive, multicellular organisms face additional difficulties in organizing their desiccation response because they must sense and react to environmental cues that indicate dehydration and coordinate a response across tissues to enable the animal to survive [19]. This requires precise control over both space and time. Though a few strategies for achieving this coordination and sensing have been suggested, little is understood about the underlying regulatory processes that occur between an organism's existence and a cell's survival [20].

One of the most stressful situations for cattle is heat stress, which has negative effects on productivity, health, and product quality [21]. Because of their fast development and metabolism, high production levels, and species-specific traits such as rumen fermentation, impaired perspiration, and epidermal insulation, animals are vulnerable to heat stress. Acute heat stress just before slaughter can cause pale, mushy, and exudative meat with a low water-holding capacity by stimulating muscle glycogenolysis [22]. Chronically hot-stressed animals have lower muscle glycogen stores, which results in dark, hard, and dry meat with elevated WHC and final pH. Because of bacterial proliferation and shedding, heat stress causes oxidative stress, lipid and protein oxidation, decreased shelf life, and compromised food safety [23].

Many vertebrate species are better able to tolerate hypoxia than humans. For instance, turtles can tolerate a hypoxic environment (100% N2) for several hours without any apparent adverse effects [24]. Hypoxia tolerance isn't restricted to heterothermic animals either. Some marine mammals, like the great white shark, can dive for up to two hours without any apparent ill effects many of the animal's strategies for tolerating hypoxic stress are still poorly understood [25]. Ability to reduce metabolic rate under hypoxia, ability to recruit alternative metabolic pathways for energy generation, ability to have a left-shifted Oxy-haemoglobin dissociation curve, improved pulmonary gas exchange, and ability to change blood flow distribution during hypoxic stress [26].

Conclusion and Future perceptive:

According to the findings, stressful environmental conditions that cause cellular homeostasis to be disrupted can activate stress response mechanisms, which both boost cells' capacity to tolerate and adapt to this disruption of homeostasis and encourage behavioural responses that help the organism avoid these conditions and minimize their effects [27]. Although a clear causal cause has not yet been identified, it has long been known that stress and disease susceptibility are related in domestic farm animals. Numerous researchers have linked stress to the host's immune system being suppressed, which opens the door for opportunistic infections to infiltrate [28]. Moreover, a wealth of data indicates that glucocorticoids facilitate this immunosuppression after a stressor activates the hypothalamic-pituitary-adrenocortical (HPA) axis. Recent findings, however, point to the possibility that stress may actually strengthen immunity and that it is not only immunosuppressive, given its link to elevated glucocorticoid concentrations [29-30]. Since neither an excessive nor an insufficient activation of immune components is optimum for disease prevention, vulnerability to disease may grow in either scenario.

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GENETICALLY MODIFIED ANIMALS – POTENTIAL BENEFITS AND ETHICAL ISSUES

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Introduction:

Genetically modified animals hold significant promise in various fields, from agriculture to medicine. By introducing specific genetic modifications, scientist can enhance livestock to produce more nutritious meat or milk, potentially addressing food insecurity and malnutrition. Additionally, genetically modified animals can serve as a model for studying human diseases, leading to advancements in biomedical research and the development of new therapies. Genetically modified animals offer a wide range of potential benefits, such as increased resistance to diseases, improved growth rates, and enhanced nutrient content in food products. These modifications can help to address challenges in agriculture such as reducing the need for antibiotics and pesticides while also potentially improving animal welfare through diseased susceptibility to illnesses. However, ethical concerns surrounding the welfare of these animals, the potential environmental impacts of releasing modified organisms into the wild and the long-term effects on ecosystem must be carefully considered. Ethical concerns arise regarding animal suffering, environmental impacts and the potential for genetic modifications to spread to wild population. Striking a balance between realizing the benefits of genetic modification and upholding ethical principles is crucial for the responsible advancement of this technology.

Genetically modified animals

The ability to modify an organism's genome was revolutionized in the 1980s by a technology called transgenesis. In order to model human disease or determine whether specific mutations cause a disease, scientists were able to add genes and alter specific genes in a living organism for the first time. The method is also employed to examine a gene's typical function within a living thing. The animals referred to as transgenic or genetically modified (gm) are comprised of foreign dna, frequently duplicate copies of a gene from a different species, perhaps human.

The most popular method for creating genetically modified animals is "microinjection", which is the process of inserting foreign dna into a fertilized egg. In mammals the injectable eggs are transferred into a foster mother, where they mature and give birth normal offspring with the additional, foreign dna. Since this dna is now a part of a chromosome, that transgene is inherited similarly to other dna when the gm animals makes and give birth to offspring and a line of gm animals is developed that carries the extra dna. The first genetically modified animal was created in the early 1980s and the most mammals including fish, cattle, pigs, sheep and poultry have benefited from this technique.

Transgenic animals and their uses

Transgenic fish

Super fish: Super fish or transgenic salmon grows about 11 times faster than normal fish. In this fish, growth hormone gene is inserted into the fertilized eggs.

Glo fish: Glo fish also called as fresh water zebra fish. It is produced by integrating a fluorescent protein gene from the jelly fish into the embryo of fish.

Transgenic mouse

Alzheimer's mouse: Amyloid, a protein entangles dead nerve cells in the brains of alzheimer's patients. This mouse created by in certain inserting the amyloid precursor gene into the fertilized egg of the mouse.

Oncomouse: Cancer research using a mouse model created through oncogene insertion.

Smart mouse: A biological model designed to increase the amount of nr2b receptor in the neural network. As a result, the mice learn more quickly throughout their lives much like the young mice do.

Transgenic pig

Enviro pig: A substance called phytate, which is present in a lot of cereal grains fed to pigs is difficult for them to completely digest. The *E. coli* phytase gene is introduced to produce enviro pig. The pig's salivary gland there by produces the enzyme phytase. It breaks downs indigestible phytate by releasing phosphate that pigs can easily absorb.

Pig for organ transplant: Human genes are injected into the pigs in order to reduce the chance of organ rejection by a human body.

Transgenic livestock

Transgenic cattle:

- Lactoferrin and interferon proteins are produced in the milk of transgenic cow.
- Mad cow disease resistant bovines devoid of parasites.

Transgenic sheep: To produce wool of high quality.

Transgenic goat: Genetically modified goats whose milk may contain spider silk, tissue plasminogen activator and anti-thrombin iii.

Transgenic rabbit: Transgenic rabbit is enhanced with green-fluorescent protein. It is created in 2000 as a transgenic artwork.

Transgenic monkey:

- It is born in 2000 named andi was the first transgenic monkey.
- The acronym "andi" represents "inserted dna" written backwards.
- The green fluorescent protein gene was created and inserted into andi's rhesus genome posing no harm.

Potential benefits of genetically modified animals

GM animals in medical research

The science of genetic alteration applied to animals can be utilized to develop human disease models for medical research. These models are beneficial and used to clarify disease processes and enable evaluation of novel treatments.

Disease model: Genetically modified animals, often rodents like mice are engineered to carry specific human disease-related genes. These models help researchers to study the progression and mechanisms of disease like cancer, alzheimer's and diabetes, providing valuable insights into potential treatments.

Drug development and testing: GM animals are used to test the efficacy and safety of new drugs. By mimicking human genetic conditions, these animals aid in assessing how potential treatments might behave in a living organism, helping researches identify promising drug candidates and understand potential side effects.

Biopharmaceutical production: Some genetically modified animals such as goats and cows are engineered to produce therapeutic proteins or drugs in their milk. This biopharming approach provides a cost-effective method for producing complex proteins that can be used in medical treatments including clotting factors and antibodies.

Organ transplants and studying genetic disorders: GM animals help researchers to study the genetic basis of human disorders. For example, mice with modified genes associated with cystic fibrosis allow scientists to understand the diseases molecular mechanisms and develop targeted therapies.

Cancer research: Genetically modified mice are widely used in cancer research to better understand the genetic factors influencing tumor development. These models aid in testing new cancer treatments and studying the underlying genetics of various types of cancer.

Gene therapy research: GM animals serve as models for testing gene therapy approaches. Researchers can study the effects of introducing, modifying, or silencing specific genes, providing critical insights into the development and optimization of gene therapy techniques for human diseases.

Vaccine development: GM animals can be engineered to express components of pathogens, aiding in the development and testing of vaccines. This approach helps researchers to understand immune responses and enhance vaccine efficacy.

Xenotransplantation

The creation of genetically modified (gm) pigs with a human gene that could stop the acute rejection of organ transplants between pigs and humans was one of the first genetic changes of larger animals. Xenotransplantation is the process of transplanting tissues from one species to another. Graft rejection results from the recipient's antibodies attacking the donated organ whenever pig tissue is transferred into a different species. Rejection of the transplant can be avoided by altering certain proteins on cells known as complement control proteins, which trigger the body's immunological response.

GM animals in agriculture

Improved disease resistance: GM animals can be engineered to be more resistant to diseases, reducing the need for antibiotics and other medications, which can help to address concerns about antibiotic resistance and animal welfare.

Enhanced growth rate: Genetic modifications can be made to promote faster growth rates in animals, leading to increased efficiency in meat and dairy production.

Nutritional enhancement: Animals can be genetically modified to produce healthier meat, milk, or eggs with higher levels of essential nutrients, such as omega-3 fatty acids or vitamins.

Environmental sustainability: GM animals can be engineered to produce less waste or to be more efficient in converting feed into meat or other products, potentially reducing environmental impacts associated with livestock farming.

Reduced allergenicity: Genetic modifications can be used to reduce allergenic properties in animal products, making them safer for consumption by individuals with food allergies.

Customized traits: GM technology allows for the precise modification of specific traits in animals, such as improved wool quality in sheep or increased milk production in cows, to better meet consumer demands and industry needs.

Biosecurity: Genetically modifying animals to be resistant to certain pathogens or pests can enhance biosecurity measures on farms, reducing the risk of disease outbreaks and improving overall animal health.

GM insects

Pest control: Genetically modified insects can be engineered to carry traits that make them effective in controlling agricultural pests. For example, they can be designed to produce sterile offspring or to carry genes that inhibit the reproduction of pest species, reducing the need for chemical pesticides.

Disease control: Insects such as mosquitoes can be genetically modified to reduce their ability to transmit diseases like malaria, dengue fever, or zika virus. This approach can help in disease prevention and control, particularly in regions where these diseases are endemic.

Crop protection: Genetically modified insects can be developed to target specific crop pests, reducing damage to crops and improving yields. This can contribute to more sustainable agricultural practices by decreasing the reliance on chemical pesticides.

Environmental conservation: GM insects can be used in efforts to control invasive species that threaten native ecosystems. By targeting invasive insect populations, genetically modified insects can help preserve biodiversity and restore ecological balance.

Reduced environmental impact: Compared to chemical pesticides, genetically modified insects can provide targeted control measures that minimize collateral damage to non-target organisms and reduce chemical residues in the environment.

Resistance management: Genetically modified insects can be designed to target specific genetic vulnerabilities in pest populations, reducing the likelihood of resistance development compared to traditional chemical pesticides.

Vector control: Genetically modified insects can be used to target disease-carrying vectors like mosquitoes, helping to reduce the incidence of vector-borne diseases and improve public health outcomes.

Customized solutions: Genetic modification allows for precise control over the traits introduced into insect populations, enabling the development of tailored solutions for specific pest or disease management challenges.

GM animals in foods

Enhanced nutritional content: Genetic modification can be used to enhance the nutritional profile of animal products. For example, animals can be engineered to produce meat, milk, or eggs with increased levels of essential nutrients such as omega-3 fatty acids or vitamins.

Improved food safety: Genetic modifications can help reduce the presence of harmful substances in animal products. For instance, animals can be engineered to be more resistant to diseases or to have reduced levels of toxins in their tissues, enhancing food safety for consumers.

Increased efficiency in production: GM animals can be designed to grow faster, produce more meat or milk, or utilize feed more efficiently. This can lead to increased productivity and lower costs for producers, potentially resulting in more affordable food prices for consumers.

Reduced environmental impact: Genetically modified animals can contribute to more sustainable food production systems by reducing the environmental footprint of agriculture. For example, animals engineered to require less feed or produce less waste can help minimize resource usage and mitigate pollution.

Disease resistance: Genetic modification can confer resistance to diseases in animals, reducing the need for antibiotics or other medications in livestock farming. This can help address concerns about antibiotic resistance and promote animal welfare.

Customized food products: Genetic modification allows for the customization of animal products to meet specific consumer preferences and dietary needs. For example, animals can be engineered to produce meat with specific flavor profiles or to have reduced allergenic properties.

Improved animal welfare: Genetic modifications can be used to enhance the health and welfare of farm animals, such as by reducing susceptibility to certain diseases or improving stress tolerance. This can lead to better animal welfare outcomes throughout the food production process.

Ethical issues of genetically modified animals

Genetically modified (gm) animals present a myriad of ethical dilemmas that demand careful consideration. Chief among these concerns is the welfare of the animals themselves. Altering their genetic makeup could potentially lead to unforeseen health issues or suffering, raising questions about the moral implications of subjecting animals to genetic manipulation without their consent. Moreover, the release of gm animals into the environment poses significant risks, including ecological disruption and unintended consequences for native species. Ensuring the containment and rigorous regulation of gm animals becomes imperative to mitigate these risks. Additionally, questions of equity and justice emerge regarding access to gm technology and its benefits, as disparities in resource distribution may exacerbate existing inequalities. Transparency, robust regulatory oversight, and ongoing dialogue among stakeholders are essential to navigate these complex ethical issues and ensure responsible research and application of gm animal technologies.

Animal welfare: Altering an animal's genetic makeup can potentially lead to unforeseen health issues or suffering. Ensuring the well-being of gm animals throughout their lives is a crucial ethical consideration.

Environmental impact: GM animals released into the wild could disrupt ecosystems if they breed with wild populations or outcompete native species. Containment measures must be rigorous to prevent unintended consequences.

Consent and autonomy: Animals cannot provide consent for genetic modification, raising questions about respect for their autonomy and whether humans have the right to manipulate their genetic makeup.

Unpredictable consequences: Genetic modifications may have unintended consequences, both for the individual animal and the broader environment. Ethical concerns arise from the potential risks associated with releasing gm animals into ecosystems.

Equity and justice: Access to gm technology and its benefits may not be equally distributed, raising issues of social justice and exacerbating existing disparities in resource distribution.

Long-term effects: It's challenging to predict the long-term effects of genetic modifications on animal populations and ecosystems, which underscores the need for cautious and responsible research and regulation. Concern regarding the potential long-term health effects of genetic modifications on gm animals, as well as any potential impacts on human health if these animals are used for food or biomedical research.

Interference with natural evolution: Altering the genetic makeup of animals could interfere with natural evolutionary processes, potentially leading to unforeseen consequences for ecosystems and future generations of organisms.

Moral status of gm animals: Philosophical debates surround the moral status of gm animals and whether they deserve special consideration or protection due to their altered genetic composition.

Ownership and control: Questions arise regarding ownership rights and control over gm animals, particularly in cases where patents or intellectual property rights are involved.

Transparency and public trust: Ensuring transparency in research, development, and application of gm animal technologies is essential for maintaining public trust and addressing concerns about accountability and oversight.

Recent development in genetically modified animals

GM cow:

- Researchers in china and argentina have utilized genetic engineering to modify cows' milk to resemble human milk in terms of composition.

- An argentinean cow named rosa isa was created by the modification of embryos to produce milk that had proteins seen in human milk but not in cow milk.
- Several scientific, safety, and taste concerns would need to be resolved before this could take the role of "mother's milk" for young children.

GM goat:

- The trademark name bio steel refers to a high-strength fiber material manufactured by nexia biotechnologies from recombinant spider silk-like protein that is derived from the milk of transgenic goats.
- The company has effectively produced several goat lines that yield recombinant forms of the maspl or maspll dragline silk proteins, respectively, in their milk.

GM pigs:

- Scientists have made previously unthinkable progress toward creating pigs that are advantageous to humans through genetic modification.
- Creating models of human diseases, producing medications, and supplying organs for human xenotransplantation are all advantages for medicine.
- The advantages of agriculture include disease resistance, enhancing the pigs' ability to withstand heat stress, changing the carcass composition to make it healthier to eat, and environmental protection.
- It is likely that other kinds of genetic engineering will give animals traits that will help humans in ways that are not yet known.

GM sheep:

- The roslin institute is using genome editing technologies to boost sheep breeds intended for the meat industry's productivity.
- Animals with naturally occurring mutations that prevent the action of a gene called myostatin have been found to have up to 20% greater muscle mass than animals without the mutations.
- Animals harboring myostatin mutations demonstrate improved feed-to-muscle conversion, thereby enhancing meat production efficiency and reducing resource requirements.
- These animals also produce meat that is healthier, of greater quality, and has less fat in it.

GM chickens

- The roslin institute is developing genetically modified chickens with an additional gene that prevents the avian flu from spreading.

- In contrast to a vaccination, in the event that the virus mutates, the alteration keeps the bird safe.
- Yet, some farmers feel that enforcing proper farming techniques is preferable to breeding animals devoid of disease.

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BLOODSTAIN PATTERN VISUAL ANALYSIS (BPVA) IN FORENSIC SCIENCE USING SUPERVISED LEARNING AND HYPERSPECTRAL IMAGING

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Abstract:

The aim of this chapter/paper is to analysis the blood stain in the crime scene either if it is fresh stain or dry stain. Here, the visual analysis is comprised on three stages to give a complete report about the crime scene. The stages of analysis are normal view analysis, microscopic view analysis and spectroscopic view analysis. All type of analysis is by supervised Learning system. Every blood stain has different phases which demonstrate about the scene of crime for example blood drop in 90^0 forms a spherical shape stain, lot of blood spray forms different shapes of stain, as well as blood appearing on the type surface either bare ground or clothes or in any other object needs different kind of examination. We have analyse that the blood is belong to human or not, and the blood belongs to whom or belongs to which part and also did the blood stain is ante-mortem or post-mortem one etc and that could be analyse by chemo metrics analysis on machine learning, every little thing has to be examined by the forensic department. This paper/ chapter is going to analysis the three stages one by one.

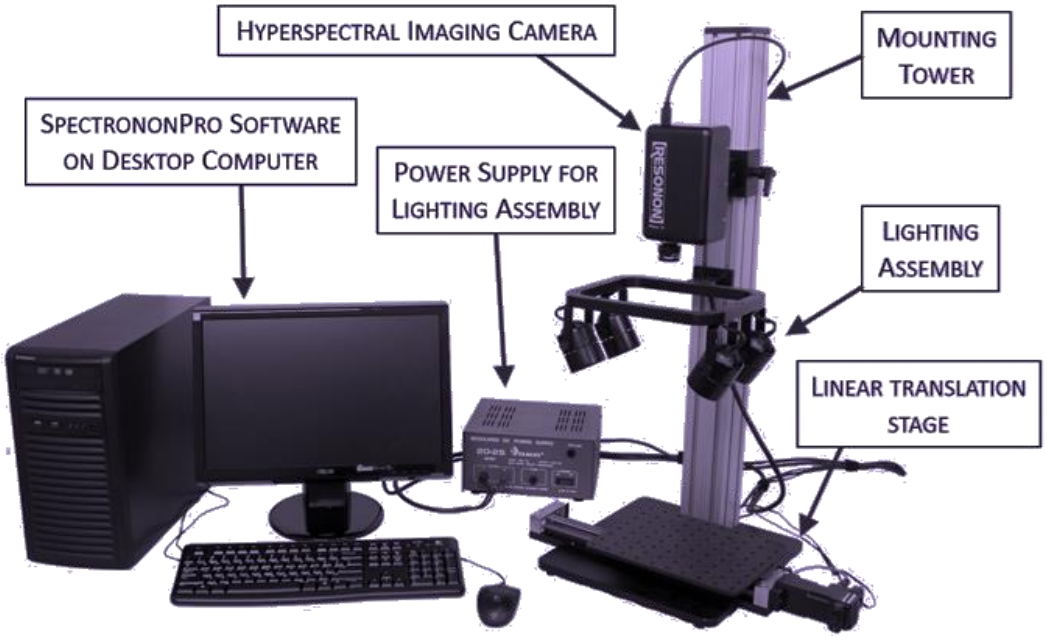
Keywords: Hyperspectral Imaging (HSI), Chemo metrics, Forensic science, Ante-mortem.

Introduction:

Bloodstain Pattern Visual Analysis (BPVA) in Forensic crime scene using supervised and Hyperspectral imaging. Forensic Science is the study of investigating the evidences which found in the place of crime. Based on the evidences there are lot of diverse in the case studies. This paper is concentrated on blood stain. Visual analysis is the analysing method on what we can see on the stain that is the normal photographs taken on the crime area, images collected from microscopic view and from spectroscopic view. Supervised Learning is the type of machine learning with the guidance of previously available training data, it has two categorized types of algorithms namely classification algorithms and regression algorithms. That means we can analyse and classify the given problem easily by matching with the training data set. Hyperspectral Imaging HSI is the technique of analysing the image resolution not like normal

resolution RGB pixels is analysis on a continuous spectrum curve, filtered from a narrow series of spectral bands.

Methodology:



RESONON Hyperspectral Imaging Camera set.

Bloodstain collecting process:

Bloodstain Pattern Visual Analyzer (BPVA) is a man or a program to analyze the pattern of available stain in a detail manner of third eye vision. The Father of Bloodstain Pattern Analysis was Dr. Eduard Piotrowski who was published his paper namely "Concerning the Origin, Shape, Direction and Distributions of Bloodstains following Head wounds caused by blows" in1895 at university of Krakow in Poland.

Bloodstain has categorized into several types based on its shape, size and distribution

1. Passive Bloodstain
2. Projected Bloodstain
3. Impact Spatter
4. Cast-off Bloodstain
5. Wipe Bloodstain
6. Transfer Bloodstain.

1. Passive bloodstain

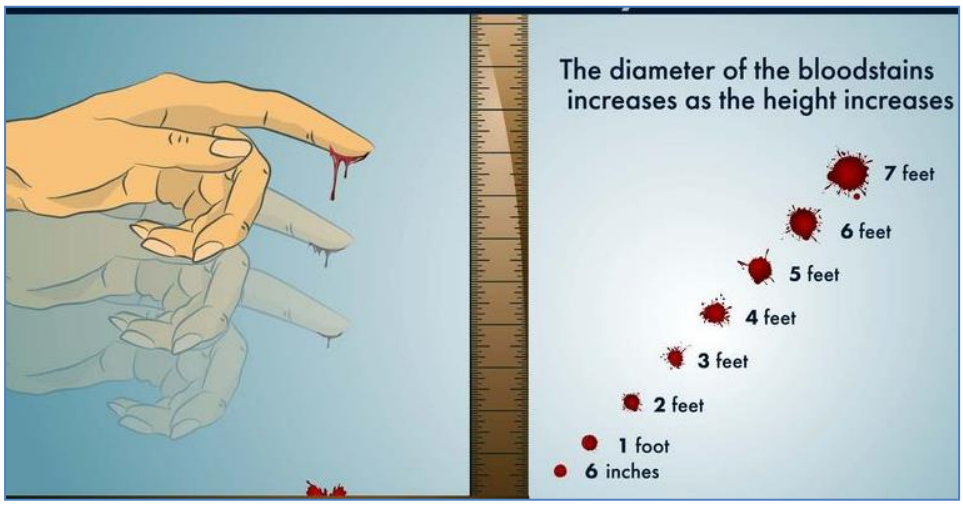
The bloodstain which is made due to force of gravity on bloodshed by the victim object is called as Passive Bloodstain blood droplets, blood clots on surface, blood flow pool on floor etc.

2. Projected bloodstain

Projected bloodstain is spatter of blood due to high pressure of force which is higher than the gravity force called blood spatter or cast-off blood. Stains formed based on the velocity, categorized by Low, Medium and High Velocity.

3. Transferred

Transferred blood stain are identify through the things which are having blood stains on them like clothes, foot prints, finger prints and wipes marks on surface.



Bloodstain impact spatter

Types of droplets

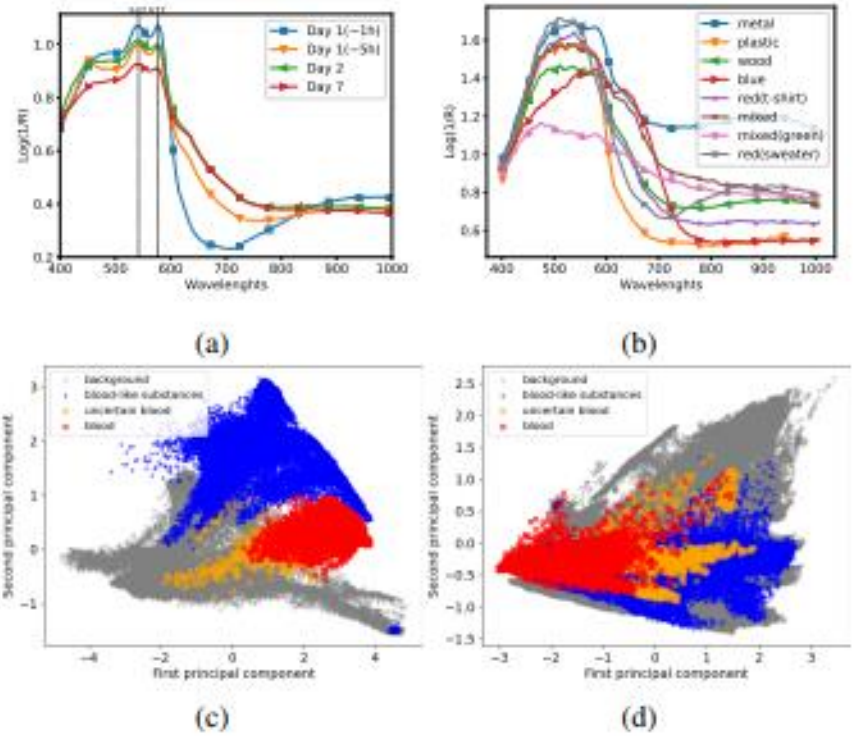
According to pattern analysis the Blood stains are differentiated into two types active stains and passive stains. Active stains are the blood stains are the bloodshed directly floor or wall or in any other objects. Passive stains are the bloodshed on any other objects transferred to another object

Implementation

```
import org.opencv.core.Core;
import org.opencv.core.CvType;
import org.opencv.core.Mat;
import org.opencv.core.MatOfPoint;
import org.opencv.core.MatOfPoint2f;
import org.opencv.core.Point;
import org.opencv.core.Scalar;
import org.opencv.core.Size;
import org.opencv.highgui.HighGui;
import org.opencv.imgcodecs.Imgcodecs;
import org.opencv.imgproc.Imgproc;
import java.util.ArrayList;
import java.util.List;
public class BloodStainAnalyzer {
```

```
static {
System.loadLibrary(Core.NATIVE_LIBRARY_NAME);
}
public static void main(String[] args) {
// Load the image
Mat originalImage = Imgcodecs.imread("path/to/your/image.jpg");
// Convert the image to grayscale
Mat grayImage = new Mat();
Imgproc.cvtColor(originalImage, grayImage, Imgproc.COLOR_BGR2GRAY);
// Apply thresholding to create a binary image
Mat binaryImage = new Mat();
Imgproc.threshold(grayImage, binaryImage, 127, 255, Imgproc.THRESH_BINARY);
// Find contours in the binary image
List<MatOfPoint> contours = new ArrayList<>();
Mat hierarchy = new Mat();
Imgproc.findContours(binaryImage, contours, hierarchy, Imgproc.RETR_EXTERNAL,
Imgproc.CHAIN_APPROX_SIMPLE);
// Analyze each contour
for (MatOfPoint contour : contours) {
MatOfPoint2f contour2f = new MatOfPoint2f(contour.toArray());
double perimeter = Imgproc.arcLength(contour2f, true);
MatOfPoint2f approxCurve = new MatOfPoint2f();
Imgproc.approxPolyDP(contour2f, approxCurve, 0.02 * perimeter, true);
int vertices = (int) approxCurve.total();
// You can add more conditions based on your specific requirements
if (vertices == 4) {
// Assuming the stain is roughly rectangular
Imgproc.drawContours(originalImage, contours, contours.indexOf(contour), new
Scalar(0, 255, 0), 2);
}
}
// Display the result
HighGui.imshow("Blood Stain Analyzer", originalImage);
HighGui.waitKey();
```

```
HighGui.destroyAllWindows();
 }
}
```



Class Number					
Code	**Blood**	**Paint**	**Beetroot**	**Tomato**	**Poster Paint**
F(1)	1	0.99	0.99	0.96	1
F(1s)	1	0.89	0.98	0.97	1
F(1a)	1	1	0.99	0.87	1
F(2)	1	0.53	0.97	1	1
F(2k)	0.53	1	0.99	1	1
F(7)	0.63	1	0.98	1	0.99
F(21)	0.7	0.99	0.98	0.3	0.98
F(1)	1	0.79	-	0.34	0.97
F(7)	1	0.99	-	0.32	0.65
F(21)	1	0.99	-	0.36	0.53

Future scope:

Hyperspectral imaging technology holds great promise for a variety of applications, including medical diagnostics, environmental monitoring, agriculture, and more. In the context of bloodstain analysis, hyperspectral imaging offers several potential advantages for classification and identification

Enhanced spectral resolution: Hyperspectral imaging provides a much finer spectral resolution compared to traditional imaging techniques. This allows for the detection of subtle differences in the spectral signatures of different materials, including bloodstains.

Discrimination of blood components: Hyperspectral imaging can potentially differentiate between various components of blood, such as hemoglobin, serum, and plasma, based on their unique spectral characteristics. This capability could aid forensic investigators in determining the age and type of bloodstains.

Improved accuracy and sensitivity: By analyzing a wide range of wavelengths, hyperspectral imaging can enhance the accuracy and sensitivity of bloodstain classification compared to conventional imaging methods. This could lead to more reliable forensic analysis and crime scene reconstruction.

Non-destructive analysis: Hyperspectral imaging is non-destructive, meaning it can capture detailed spectral information without altering or damaging the sample. This is particularly valuable in forensic investigations where preservation of evidence is critical.

Automation and machine learning: Advances in machine learning algorithms and pattern recognition techniques can be leveraged to automate the classification and analysis of hyperspectral data. By training classifiers on large datasets of spectral signatures, it may be possible to develop highly accurate models for bloodstain classification.

Portable and field-deployable systems: As hyperspectral imaging technologies continue to evolve, the size and cost of hyperspectral imaging systems are decreasing, making them more accessible for field applications. Portable hyperspectral imagers could be used by forensic teams to quickly analyze bloodstains at crime scenes.

Integration with other forensic techniques: Hyperspectral imaging can complement existing forensic techniques such as DNA analysis, fingerprinting, and chemical analysis. By integrating multiple modalities, forensic investigators can obtain a more comprehensive understanding of crime scenes and forensic evidence.

Overall, the future scope of hyperspectral image classification for bloodstain analysis is promising, with potential applications in forensic science, law enforcement, and criminal investigation. However, further research and development are needed to fully realize the capabilities of hyperspectral imaging in this domain, including the refinement of image processing algorithms, the development of standardized protocols, and the validation of results through extensive testing and validation studies.

Conclusion:

In conclusion, hyperspectral image processing represents a powerful and versatile tool with wide-ranging applications across various fields including environmental monitoring, agriculture, medical diagnostics, remote sensing, and forensic science. The technology's ability to capture detailed spectral information across a wide range of wavelengths offers significant advantages over conventional imaging techniques.

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OCEAN ACIDIFICATION

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Abstract:

Ocean acidification, a consequence of increased atmospheric carbon dioxide (CO_2) levels, poses a significant threat to marine ecosystems worldwide. This phenomenon results from the ocean's absorption of excess CO_2, leading to a decrease in seawater pH and alterations in carbonate chemistry. The repercussions of ocean acidification are widespread, affecting various marine organisms, from microscopic plankton to large marine species As CO_2 emissions continue to rise, the acidification of oceans accelerates, posing threats to marine biodiversity, fisheries, and the overall health of marine ecosystems. Shell-forming organisms such as corals, mollusks, and some planktonic species face challenges in maintaining their calcium carbonate structures, which can have cascading effects on the food web. It emphasizes the importance of understanding pH fluctuations, challenges in mitigating OA's impact, and the necessity of global collaboration for effective policy development and adaptation strategies.

Keywords: Ocean acidification, Calcifying organisms, Marine ecosystems, Seawater chemistry, Socio-economic implications

Introduction:

Definition and explanation of ocean acidification

Ocean acidification, referred to as OA, describes the gradual decrease in the ocean's pH due to the absorption of carbon dioxide (CO_2) from the atmosphere. Several factors, including changes in land use and the burning of fossil fuels, contribute to increased CO_2 levels. This absorption of CO_2 by the ocean, estimated at around 30%, triggers various chemical reactions. As a result, there's an increase in hydrogen ion concentration and seawater acidity, along with a decrease in the availability of CO_{32}- ions [1]. This shift leads to challenges for organisms reliant

on $CaCO_3$ minerals for their shells and structures, like deep-sea corals, clams, and calcareous plankton. Even non-calcifying organisms, coastal estuaries, and waterways are affected by these alterations in ocean chemistry. Figure 1 illustrates the chemical reactions associated with ocean acidification, showcasing various stages and resulting products.

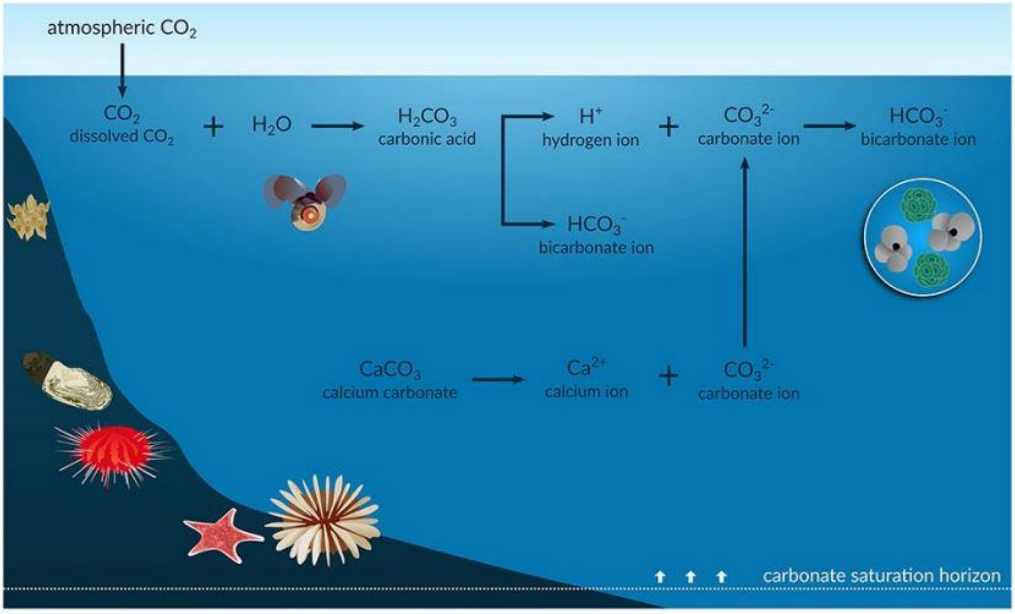

Fig. 1: Chemical reactions of ocean acidification with showing distinct stages and products (Source: https://reaktoro.org/applications/solubility/solubility-calcite-on-acidity-and-temperature.html)

The declining carbonate ion concentration particularly impacts calcifying organisms, hindering their ability to produce and maintain shells and $CaCO_3$ structures. The repercussions of this extend throughout the ocean's food web. Even small pH changes in seawater have immediate adverse effects on the ecosystem. Perhaps most notably, ocean acidification significantly harms coral reefs, disrupting the entire ecosystem they support. Coral reefs serve as vital habitats and food sources for a diverse array of marine life. It's been observed that over 4000 fish species and a quarter of marine life rely on these reefs. Corals, crucial for these ecosystems, construct their stony skeletons from $CaCO_3$, rendering them vulnerable to dissolution under acidic conditions caused by ocean acidification [2].

Significance and importance of ocean pH balance for marine life

The balance of ocean pH holds immense importance for marine life as it profoundly impacts their growth and survival. Ocean acidification-induced shifts in pH levels can significantly reduce calcification processes, disrupt sound transmission, modify the behavior of trace metals, and pose a threat to the very existence of marine organisms [3, 4]. Studies employing continuous, high-resolution monitoring of upper ocean pH have uncovered a

spectrum of variability, encompassing diel, semi-diurnal, and stochastic patterns [5]. These distinct pH fluctuations demonstrate that marine organisms are currently exposed to pH conditions not projected until the year 2100, indicating their current vulnerability to elevated and decreased dissolved CO_2 levels [6]. Comprehending the spatial and temporal fluctuations in seawater chemistry becomes pivotal in designing more effective ocean acidification experiments and pinpointing marine habitats that could potentially serve as sanctuaries against acidification effects [7].

Causes of ocean acidification

Ocean acidification primarily results from the ocean absorbing excessive atmospheric carbon dioxide (CO_2) [8]. The primary culprit behind this phenomenon is the escalating levels of atmospheric CO_2, largely stemming from the combustion of fossil fuels [9]. Human activities have led to the ocean soaking up roughly 30% of the carbon dioxide emitted since the industrial revolution, leading to a decline in seawater pH [10]. This drop in pH is a direct outcome of the heightened partial pressure of carbon dioxide (pCO_2), which in turn reduces seawater pH and $CaCO_3$ saturation [11]. Surface ocean pH has decreased by approximately 34.91% from pre-industrial levels [12]. Moreover, factors such as eutrophication and the natural amplification of CO_2 in coastal regions can exacerbate ocean acidification. These combined factors contribute to the acidification of the ocean, posing a significant threat to marine life and ecosystems.

A. Carbon dioxide (CO_2) absorption and chemical reactions

Ocean acidification primarily occurs due to the absorption of carbon dioxide (CO_2) from human-related sources into the oceans. When CO_2 dissolves in seawater, it reacts and forms bicarbonate (HCO_3-) and protons (H+), triggering alterations in ocean pH and carbonate chemistry [13]. Although oceans can absorb a substantial amount of CO_2, the current absorption rate exceeds the buffering capacity, leading to significant shifts in ocean pH and carbonate ion concentrations [14]. Consequently, global average ocean pH has already dropped by 0.1 since pre-industrial times, and unabated CO_2 emissions could drive further decreases of up to 0.4 by 2100 and 0.77 by 2300 [15] [16]. These changes pose a threat to marine organisms, especially those relying on calcium carbonate to construct shells, tests, and skeletons [17]. Immediate and substantial reductions in human-induced CO_2 emissions are crucial to mitigate the global impact of ocean acidification.

B. Anthropogenic sources (Fossil fuel burning, deforestation)

Ocean acidification primarily results from the escalating concentration of carbon dioxide (CO_2) in the atmosphere, stemming from activities like fossil fuel combustion and deforestation [18]. These practices release substantial CO_2 amounts into the atmosphere, and a notable portion

is absorbed by the oceans. As CO_2 dissolves in seawater, it prompts a pH decrease, leading to increased acidity. This acidification process poses a grave threat to marine organisms, especially those reliant on calcium carbonate for their shells or skeletons, like corals, snails, shellfish, and plankton [19]. The repercussions of ocean acidification on these organisms can trigger ripple effects across entire marine ecosystems, disrupting crucial biological processes and potentially causing extinctions. Immediate and significant reductions in human-generated CO_2 emissions are imperative to alleviate the impact of ocean acidification on marine life.

Chemical processes and impacts

1. Explanation of carbonate chemistry and pH levels

Ocean acidification emerges from the absorption of human-generated CO_2 emissions by the ocean, leading to observable shifts in carbonate chemistry and a decline in pH levels. The global average pH in the ocean has already dropped by 0.1, and forecasts suggest potential decreases of 0.4 by 2100 and 0.77 by 2300 [20]. These alterations in pH and carbonate chemistry present a threat to marine organisms, influencing critical biological functions such as productivity, calcification, and embryo development [21]. Various cultivation methods for microalgae can also influence carbonate systems, with pH rising during light periods and falling during dark periods [22]. Corals possess a mechanism to regulate carbonate chemistry within their Extracellular Calcifying Medium (ECM), buffering the effects of acidification and enabling continued $CaCO_3$ production [23]. Coastal regions, including seagrass beds, undergo notable pH and carbonate chemistry fluctuations due to photosynthetic and respiratory processes [24]. Overall, comprehending carbonate chemistry and pH levels is pivotal for assessing the repercussions of ocean acidification on marine organisms and ecosystems.

2. Effects on marine organisms' physiology and ecosystems

Ocean acidification profoundly impacts marine organisms' physiology and ecosystems. Research reveals that it can trigger alterations in growth, behavior, gene expression, and overall physiological health across various marine species [25]. Highly calcifying species are notably susceptible to lowered ocean pH, posing a threat to marine ecosystems [26]. Furthermore, the combined influence of ocean acidification and rising temperatures can result in habitat loss and a shift toward simpler turf-dominated ecosystems, potentially affecting resource provision [27].

However, identifying and attributing the effects of ocean acidification in natural settings pose challenges due to concurrent environmental changes and the relatively small pH changes compared to natural variability [28]. Further exploration is essential to gain a deeper understanding of and predict the impacts of ocean acidification on marine organisms and

ecosystems. This research can pave the way for the development of strategies to mitigate these effects.

3. Coral bleaching and its consequences

Coral bleaching, a consequence of increasing atmospheric carbon dioxide concentrations leading to ocean acidification, poses a threat to coral reef structure and function. Studies have primarily focused on measuring alterations in seawater carbon chemistry and understanding how reef organisms respond biologically and geochemically to these changes. However, limited attention has been given to conservation planning and management priorities concerning ocean acidification. Adaptation of existing marine protected area design principles formulated for coral bleaching may offer a starting point to address ocean acidification.

Key research areas include establishing baseline ocean carbon chemistry and ecological parameters, assessing the sensitivity of species, habitats, and communities to ocean acidification, and projecting potential changes in coral reef ecosystems. In the Pacific Basin, coral reef ecosystems face heightened vulnerability due to a combination of climatic and non-climatic stressors, including ocean acidification. Responses to these threats vary widely across the region and have associated socio-economic impacts [29]. Figure 2 displays the impact of ocean acidification on coral reefs.

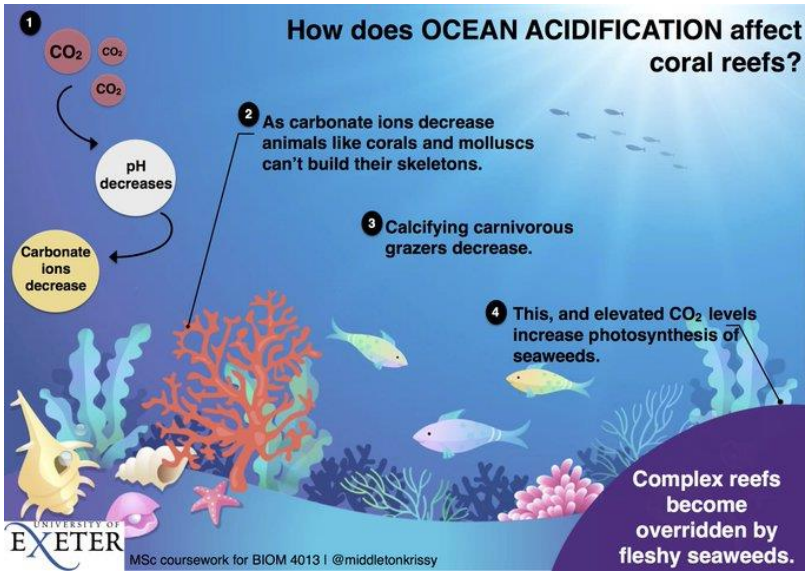

Fig. 2: Effect of ocean acidification on coral reef. (Source: middletonkrissy)

Impact on marine life

A. Shell-forming organisms and their vulnerability

Ocean acidification presents a considerable danger to creatures that form shells. The rise in carbon dioxide in the atmosphere causes a decline in carbonate ions and the saturation level of seawater. This change makes it harder for shell-building marine organisms to create their

protective shells or skeletons [30]. Planktic foraminifers, which produce shells, are particularly sensitive to higher ocean carbon dioxide levels. Experts predict that ongoing acidification will likely decrease the ability of these organisms to produce carbonate [31]. Giant clams demonstrate some resilience to moderate acidification but still display lower rates of shell formation, indicating their sensitivity to this environmental change [32]. Acidification significantly threatens oysters and other shell-producing organisms; as the pH of their aquatic habitat decreases, their shells thin out noticeably [33]. The susceptibility of various marine shell builders to ocean acidification varies based on their skeletal mineral makeup. Species with calcitic, aragonitic, and high-Mg calcite compositions are generally more vulnerable [34]. Figure 3 depicts the influence of ocean acidification on organisms involved in shell formation.

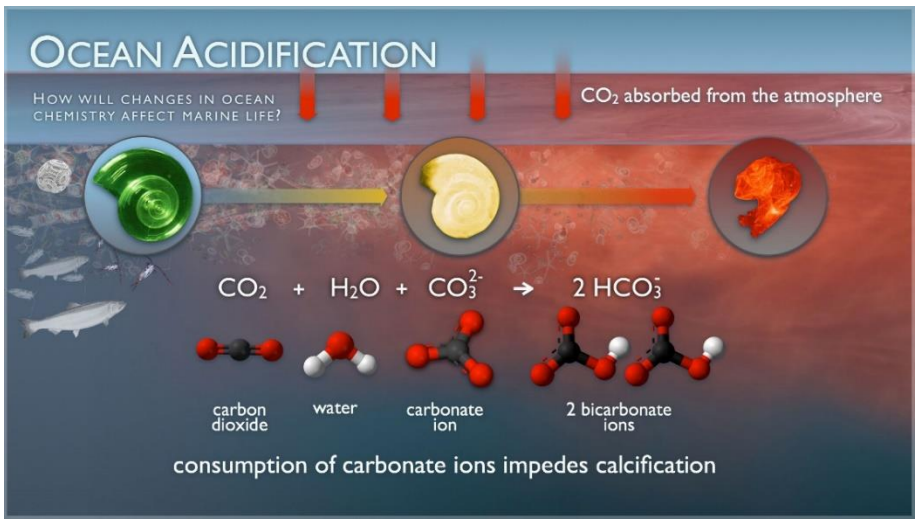

Fig. 3: Effect of ocean acidification on shell forming organisms (Source: NOAA)

B. Food web disruptions and species migrations

Ocean acidification can cause disruptions in food chains and trigger species migrations. When the acidity of the oceans increases, a harmful microalga called *Vicicitus globosus* gains an advantage, multiplying and forming blooms. These blooms disrupt the transfer of nutrients between trophic levels, resulting in a decrease in the export of essential elements [35]. Interestingly, in a controlled environment study, the survival rate of Atlantic herring larvae actually improved under conditions projected for the end of this century, possibly due to an increase in primary production stimulated by higher CO_2 levels [36]. Models also indicate that ocean acidification might alter the biomass of species that create habitats, leading to a cascade effect on marine communities and a decline in ecosystem services [37].

Moreover, experiments conducted in enclosed marine environments (mesocosms) demonstrated that the combination of ocean acidification and warming reduced the flow of energy through complex food webs. This led to a shift towards a system more reliant on detritus

and altered the dynamics between producers and consumers [38]. These findings collectively emphasize the potential significant impacts of ocean acidification on food webs and the distribution of species.

C. Altered reproduction and growth rates

Ocean acidification significantly impacts the reproduction and growth rates of marine organisms. As atmospheric carbon dioxide levels increase, oceans become more acidic, adversely affecting the reproductive and growth capabilities of bivalve mollusks [39]. Interestingly, certain fish species exhibit an unexpected positive reaction to ocean acidification. Research at natural CO_2 vents revealed that heightened CO_2 levels actually stimulated fish reproduction by boosting their energy reserves. Female fish reduced their activity to allocate more energy towards reproduction, while males increased their energy intake by intensifying foraging efforts on more abundant prey [40].

Moreover, exposure to high CO_2 levels (hypercapnia) affects intermediary metabolism in gilthead seabream, disrupting their acid-base balance and osmoregulatory functions [41]. Investigating the transgenerational effects of ocean acidification on copepods showed that prolonged exposure led to increased adaptation to acidic conditions. However, this adaptation came at a cost, as energy allocation towards development and reproduction decreased [42]. Overall, ocean acidification detrimentally affects reproduction and growth rates, although the responses vary based on species and specific environmental conditions [43].

Human-Related Consequences

A. Economic impacts on fisheries and coastal communities

Ocean acidification is poised to profoundly affect fisheries and coastal communities. Studies indicate that the alterations in seawater chemistry due to increased carbon dioxide emissions will prompt shifts in marine ecosystems, leading to diminished calcified habitats and a loss of biodiversity [44]. These changes pose a threat to coastal protection and the provisioning of habitats vital for fisheries, potentially impacting the millions reliant on these resources [45]. Despite the significance of these potential impacts, understanding the economic repercussions remains limited within current literature [46, 47].

Projections, however, paint a concerning picture. By the century's end, substantial economic damages are anticipated, with estimated annual losses per capita ranging significantly [48]. It becomes crucial to incorporate ocean acidification considerations into fisheries and aquaculture management strategies. Monitoring its impacts becomes essential for developing adaptive measures in affected regions. This proactive approach can aid in mitigating the potential adversities arising from ocean acidification.

B. Risks to food security and global implications

Ocean acidification presents a significant threat to global food security and carries far-reaching implications. The rise in atmospheric carbon dioxide levels is elevating seawater acidity, directly impacting marine ecosystems and biodiversity. This acidification process restricts the ocean's ability to absorb carbon dioxide, potentially jeopardizing food security. Moreover, the economic repercussions of ocean acidification could be substantial. Mitigating these risks necessitates a reduction in carbon dioxide emissions to curtail long-term impacts.

The severity and rapidity of ocean acidification, alongside the exposure and susceptibility of various organisms, contribute to the risk of disrupting ecosystem structure and function. Food webs containing vulnerable organisms, particularly those in polar, sub-polar, deep sea, and upwelling regions, face heightened risks. Understanding the impacts of ocean acidification on marine ecosystems and fisheries demands further comprehensive study and modeling. This continued research is crucial to guide future analyses and shape strategies for mitigating the potential ramifications of ocean acidification [49].

C. Socio-economic responses and adaptations

Socio-economic responses and adaptations to ocean acidification encompass several crucial steps, including comprehending the risks, evaluating exposure, and assessing potential opportunities [50]. Small Island Developing States (SIDS) face substantial threats stemming from ocean acidification, such as more frequent occurrences of toxic wild-caught seafood and the potential degradation of coral reef structures and habitats. Despite these challenges, SIDS might possess relative strengths in aquaculture and contribute significantly to global marine ecosystem conservation efforts [51].

Governments and regions worldwide are taking proactive steps to address ocean acidification, employing diverse strategies like enacting legislation, initiating community-driven projects, and aligning with broader environmental initiatives [52]. These actions serve to assist communities reliant on marine resources in adapting to current ocean acidification challenges and preparing for future impacts [53]. Recognizing the potential effects of ocean acidification and devising approaches for both mitigation and adaptation are imperative. Ocean science, with its significant contributions, holds a pivotal role in shaping these strategies [54].

Mitigation and solutions

A. Reduction of CO_2 emissions and mitigation strategies

Addressing the issue of ocean acidification is paramount, necessitating a focus on reducing CO_2 emissions and implementing effective mitigation strategies. The oceans' absorption of CO_2 has triggered alterations in seawater chemistry, leading to a decline in pH levels and

carbonate ion concentrations [55]. This transformation poses a significant threat to marine life, especially organisms reliant on calcium carbonate for shell and skeleton formation [56]. To tackle ocean acidification, urgent and substantial cuts in anthropogenic CO_2 emissions are imperative [57].

Furthermore, active Carbon Dioxide Removal (CDR) methods, such as marine alkalinisation, have been proposed as potential remedies [58]. Research indicates that ocean alkalinisation can enhance the seas' carbon dioxide absorption rate, mitigating acidification [59]. However, the successful application of CDR techniques necessitates concurrent and aggressive climate action to be truly effective. It is crucial to carefully evaluate the physiological and ecological implications of these mitigation strategies to ensure their safe and sustainable implementation. Figure 4 represents the concept of marine alkalinization.

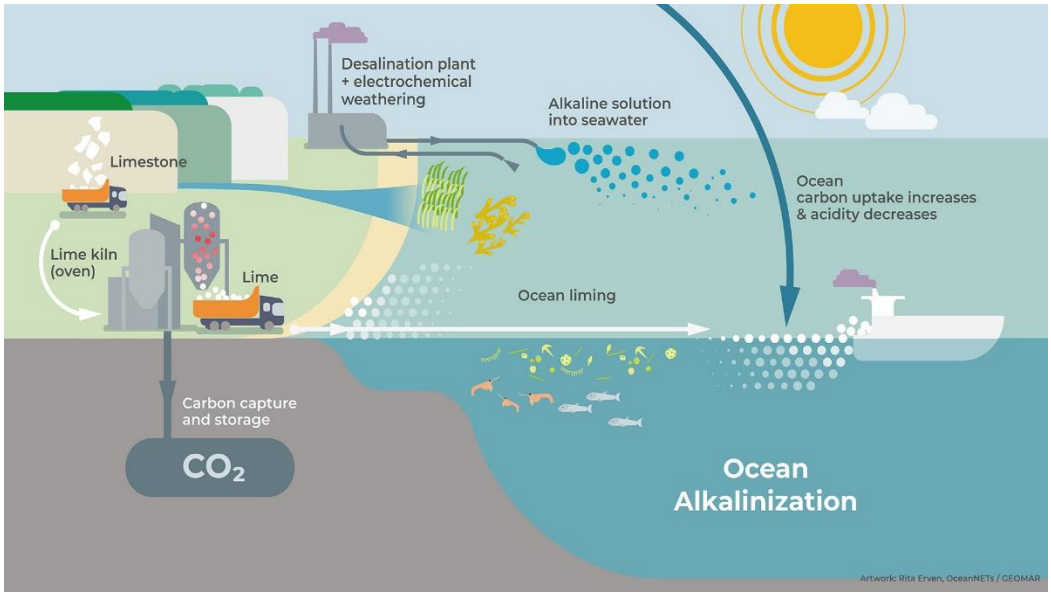

Fig. 4: marine alkalinisation (Source: GEOMAR)

B. Restoration and conservation efforts for affected habitats

Mitigating the adverse impacts of global seawater pH decline, particularly due to ocean acidification, demands dedicated restoration and conservation initiatives for affected habitats. Macroalgae-dominated environments emerge as potential refuges for marine species in the face of these challenges [60]. These habitats exhibit the capacity to modulate seawater pH by interacting with inorganic carbon in the carbonate system, elevating pH levels in the surrounding waters. This alteration provides a sanctuary from the deleterious effects of ocean acidification for various marine species.

Notably, regions characterized by substantial macroalgal biomass, such as communities dominated by large brown macroalgae (Laminariales) in temperate zones and members of the Fucales in warmer tropical areas, are anticipated to play a pivotal role as significant refuges

against ocean acidification. Despite this potential, further comprehensive research is imperative to comprehend the broader-scale impact of macroalgal communities on seawater pH. Recognizing and incorporating these refuge areas into the management of marine resources and the selection of protected areas become crucial steps for the conservation and restoration of habitats affected by ocean acidification.

C. Research and technological advancements in marine science

To combat and seek solutions for ocean acidification, ongoing research and technological breakthroughs in marine science are making significant strides. One innovative approach involves the exploration of intraspecific hybridization as a strategy to enhance the environmental resilience of marine organisms, exemplified by the noble scallop [61]. Another focal point centers on the development of cost-effective and portable pH instruments, such as the pHyter, designed for field studies and community science applications [62].

Furthermore, concerted efforts are underway to comprehend the impacts of ocean acidification on critical ecosystems like coral reefs, with a specific emphasis on renowned sites such as the Great Barrier Reef. Research endeavors in this realm aim not only to understand the consequences but also to devise management options that effectively mitigate these effects [63]. It is acknowledged that robust mitigation strategies, including substantial reductions in CO_2 emissions and the potential early deployment of CO_2 removal techniques, are imperative to sustain favorable conditions for calcifying organisms and safeguard marine ecosystems [64]. These advancements in both research and technology collectively aspire to furnish practical solutions and inform strategic management actions, addressing the multifaceted challenges presented by ocean acidification.

Future Projections and Challenges

A. Predicted scenarios and future trends of ocean acidification

Projections for future trends in ocean acidification paint a concerning picture, indicating that the oceans' absorption of anthropogenic CO_2 emissions is causing a decline in ocean pH and saturation levels of crucial calcium carbonate minerals essential for the formation of skeletons and shells. By the year 2100, particularly under moderate emissions scenarios, it is anticipated that ocean pH will decrease by 0.3 units compared to levels a century ago [65].

The influence of carbon-climate feedbacks on ocean acidification is substantial, accelerating the onset of under-saturated conditions and hastening the decline of suitable coral reef habitats by a decade or more [66, 67]. The sensitivity of ocean acidification to these feedbacks is most pronounced in scenarios with medium to low emissions, underscoring the

imperative need for a more comprehensive understanding and characterization of these complex interactions [68].

Already, in the East China Sea, observable drops in ocean surface pH have been documented, with projections indicating potential reductions in surface seawater alkalinity of 13% under RCP2.6 and a significant 72% under RCP8.5 by the year 2300 [69]. These findings underscore the critical importance of comprehending and addressing the future impact of ocean acidification on marine ecosystems and industries, highlighting the urgency of effective mitigation strategies.

B. Innovations in adaptation and resilience-building measures

Advancements in adapting to and building resilience against ocean acidification involve several innovative measures. One key strategy is the identification of genetic variations associated with phenotypes linked to climate change [70]. This involves understanding the genetic traits that contribute to resilience in the face of changing environmental conditions. Conservation efforts aimed at preserving existing genetic diversity are also crucial for fortifying resilience to global changes [71]. Another promising approach involves the synergy of integrated multi-trophic aquaculture (IMTA) and genetic breeding methods, specifically in enhancing the climate resilience of bivalves [72]. By combining sustainable aquaculture practices with selective breeding for desirable genetic traits, this approach aims to create more robust and adaptable marine species.

Adaptive governance emerges as a critical component, offering a framework to address the uncertainty of ecosystem effects and facilitate adaptive responses to ocean acidification [73]. This entails utilizing iterative and collaborative processes across various scales, integrating adaptation into broader policy development, and adopting new models of coastal and marine governance, particularly in the aquaculture industry [74]. For the aquaculture sector to enhance its adaptive capacity, flexibility in licensing regimes, the adoption of holistic and cooperative management tools, and improved integration across policy and planning instruments are identified as essential requirements. These measures collectively contribute to fostering resilience and adaptive capabilities in the face of the challenges posed by ocean acidification.

C. Global collaboration and policy development

Efficient global collaboration and robust policy development are indispensable for effectively addressing the significant stressor of ocean acidification on marine ecosystems. Utilizing existing multilateral agreements represents a practical approach, although their scope may be somewhat limited [75]. To overcome these limitations, alternative problem frames can be

devised to spur action within current environmental regimes, leveraging the overarching goals of multilateral environmental agreements [76].

The establishment of the Global Ocean Acidification Observing Network (GOA-ON) stands as a notable initiative to furnish measurements crucial for both management and scientific understanding of ocean acidification [77]. This network is designed to enhance comprehension of global ocean acidification conditions, ecosystem responses, and modeling, relying heavily on international collaboration and data sharing [78]. A framework for assessing the readiness of ocean acidification policy serves as a valuable tool for self-assessment, enabling the identification of strengths and weaknesses in policy preparedness and guiding future prioritization efforts [79]. By leveraging these frameworks, networks like GOA-ON, and existing agreements, the synergy between global collaboration and policy development for ocean acidification can be substantially strengthened, providing a more effective and unified response to this critical environmental challenge.

Conclusion:

Ocean acidification poses a significant and pressing threat to marine life and ecosystems, primarily driven by the escalating atmospheric carbon dioxide (CO_2) emissions resulting from human activities [80]. This phenomenon leads to a reduction in ocean pH, with profound consequences for marine organisms dependent on carbonate ions and calcium carbonate minerals for the construction of shells and skeletons [81, 82]. The repercussions of ocean acidification on marine life are far-reaching and include hindered coral growth, adverse effects on oyster larvae, and a decline in the mass of plankton with calcareous skeletons [83]. Organisms in vulnerable positions within food webs, particularly in polar, sub-polar, deep-sea, and upwelling regions, face heightened risks from the impacts of ocean acidification [84]. The degree of severity, exposure, and vulnerability of organisms determines the potential for adverse effects on ecosystem structure and function. Urgent and concerted action is imperative to address this issue. This involves not only a reduction in greenhouse gas emissions but also the implementation of measures to mitigate the direct impacts of ocean acidification. By taking swift and decisive steps, we can strive to safeguard marine ecosystems and their invaluable biodiversity from the escalating threat of ocean acidification. International cooperation and proactive measures are essential in confronting ocean acidification, a significant global challenge with far-reaching implications for biodiversity conservation, sustainable development, and economic prosperity [85]. Despite the absence of a unified treaty or legal instrument specifically targeting ocean acidification, a pragmatic strategy involves leveraging existing multilateral agreements [86]. However, these agreements may face limitations in addressing ocean acidification, stemming

from structural constraints and the willingness of involved parties [87]. As a result, a comprehensive approach may involve establishing a network of agreements, each concentrating on specific facets of the problem [88]. To mobilize action within existing environmental frameworks, alternative problem frames can be developed, emphasizing the impacts of ocean acidification and aligning with the objectives of multilateral environmental agreements [89]. Recognizing that reducing global carbon dioxide emissions is fundamental to addressing climate change and mitigating ocean acidification, proactive steps are necessary. It becomes evident that addressing ocean acidification requires a multifaceted and collaborative effort, combining international cooperation, innovative problem-solving, and a commitment to reduce greenhouse gas emissions on a global scale.

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POLICY AND HABITATS OF MICE

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Abstract:

Policies and habitats for mice are critical for good management and research in animal science. Generally, Mice (Mus musculus) are adaptable organisms known for their prolific reproduction and nocturnal habits. While they are frequently considered pests in human habitats, they are essential in laboratory research due to their genetic similarity to humans and simplicity of handling. Policies and protocols promote ethical treatment in research settings by addressing issues such as housing, handling, ethics, experimental design, and data gathering. Institutional Animal Care and Use Committees (IACUCs) monitor compliance with regulations and ethical standards. By knowing mouse habits, such as nesting, feeding, burrowing, social behavior, and reproduction, is critical for successful management and study. Food supply, shelter, water supplies, temperature, predators, human activities, competition, and disease prevalence all have an impact on mouse habitats. A thorough grasp of mouse policies and habits allows researchers and practitioners to devise ethical management techniques and increase scientific knowledge in animal science. Recognizing the ethical problems surrounding the care of mice in various circumstances enables the development of recommendations that emphasize their welfare while also furthering scientific knowledge. Overall, a complex understanding of mouse policies and habits serves as the foundation for competent and ethical animal management practices, contributing to both scientific advancement and the well-being.

Keywords: Prolife reproduction, Genetic similarity, Ethical treatment, Scientific improvement, Protocol of mice.

Introduction:

Mice are small rodents that are known for their adaptability and prolific breeding habits. They typically inhabit a variety of environments, including urban areas, fields, forests, and homes. In terms of habits, mice are primarily nocturnal, meaning they are most active during the night. They are omnivorous, feeding on a wide range of foods including grains, seeds, fruits, and insects. Mice are known for their gnawing behavior, which helps them maintain their teeth and gain access to food sources. In terms of reproduction, mice breed rapidly, with females capable

of producing several offspring per year. Due to their prolific breeding and ability to adapt to different environments, mice are often considered pests when they invade human habitats, causing damage to property and transmitting diseases.

As a result, various policies and strategies are implemented to control mouse populations and minimize their impact on human health and infrastructure. Mice are commonly used in lab research due to their genetic similarity to humans and their small size, making them easier to handle. They are used in various types of research, including genetics, physiology, pharmacology, and toxicology. Mice are often genetically modified to mimic human diseases, allowing researchers to study disease progression and test potential treatments. Additionally, mice are used to understand basic biological processes and to evaluate the safety and efficacy of new drugs before human trials with some experimental procedures which may involve breeding, genetic manipulation, behavioral studies, drug administration, and tissue analysis.

Mice (*Mus musculus*) are small rodents commonly used in animal science research due to their ease of handling, short reproductive cycle, and genetic similarity to humans. They serve as valuable models for studying various biological processes, diseases, and drug responses. Their relatively low cost and fast reproduction make them ideal for large-scale studies, contributing significantly to advancements in biomedical and behavioral research. In certain contexts, mice can be considered vermin. Vermin are a major source of crop damage, as they are known to cause structural damage and spread disease through their feces and are often carriers of parasites. In north America, breathing dust that has come in contact with mouse excrement has been linked to hatavirus, which may lead to Hatavirus pulmonary syndrome (HPS). In the wild, mice are known to build intricate burrows. These burrows have long entrances and are equipped with escape tunnels. In atleast one species the architectural design of a burrrows is a genetic trait.

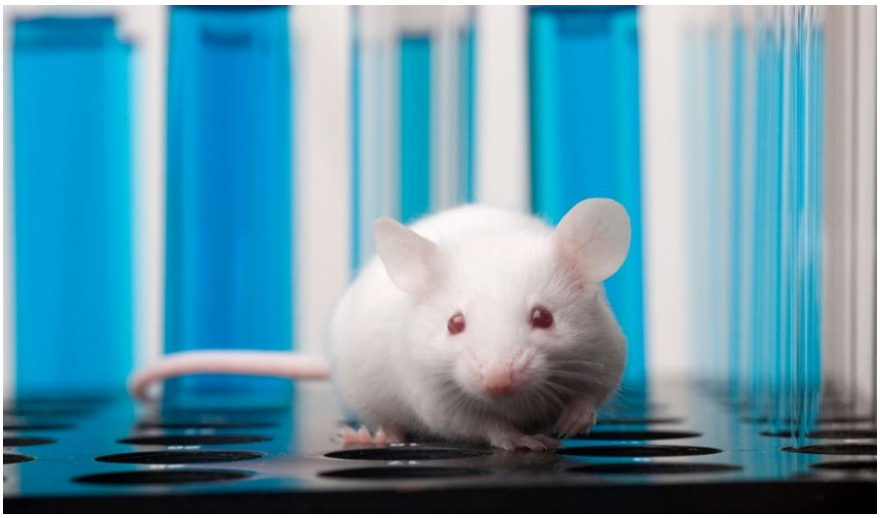

Figure 1: *Mus musculus*

Policy under mice

Policies regarding the use of mice in research typically revolve around ethical considerations, ensuring the humane treatment of animals, and adherence to regulations set by governing bodies, such as Institutional Animal Care and Use Committees (IACUC) in the United States. All policies often include guidelines for housing, care, handling, and experimental procedures involving mice. Researchers are usually required to obtain approval from the committees before conducting experiments involving animals.

Protocol of mice

The term "mice protocol" typically refers to a set of guidelines and procedures for conducting experiments involving mice in the field of animal science. Specific policies may vary depending on the institution, the nature of the research, and local regulations regarding animal welfare. It's crucial to adhere to these protocols to ensure humane treatment of animals and reliable research outcomes. These protocols generally cover aspects such as,

1. Housing conditions
2. Handling procedures
3. Ethical considerations
4. Experimental design
5. Data collection methods

1. Housing condition

The housing condition of mice is critical for their well-being and research outcomes. It typically involves providing appropriate bedding material, nesting material, adequate space, proper ventilation, temperature control, lighting cycles, and access to food and water. Maintaining cleanliness and minimizing stressors are also essential aspects of ensuring good housing conditions for mice in research settings.

2. Handling techniques

Proper handling techniques can reduce animal pain and distress which imrove animal welfares. Some of the handling techniques of mice are,

- **Ethical guidelines:** Adhere to institutional and regulatory guidelines for the ethical treatment of animals, such as those outlined by the Institutional Animal Care and Use Committee (IACUC) or equivalent regulatory bodies.
- **Training:** Personnel involved in mouse handling should undergo proper training on animal welfare, handling techniques, and safety protocols to minimize stress and ensure the well-being of the animals.

- **Hygiene:** Maintain a clean and sanitized environment to prevent the spread of diseases and contamination. This includes regular cleaning of cages, equipment, and work surfaces.
- **Proper restraint:** Handle mice gently and with care to minimize stress and avoid causing harm. Proper restraint techniques should be used to safely handle mice during procedures such as injections or sample collection.
- **Monitoring and observation:** Regularly monitor mice for signs of distress, illness, or injury. Promptly address any issues that arise and provide appropriate veterinary care when necessary.
- **Environmental enrichment:** Provide enrichment such as nesting material, toys, and social housing to promote the animals' physical and psychological well-being.
- **Record keeping:** Maintain detailed records of experimental procedures, observations, and any interventions performed to ensure transparency and reproducibility of results.
- **Reporting:** Follow guidelines for reporting experimental procedures and results in scientific publications, including adherence to the ARRIVE (Animal Research Reporting of In Vivo Experiments) guidelines.

By following these policies and guidelines, researchers can ensure that their work with mice is conducted ethically, safely, and with respect for animal welfare.

3. Ethical consideration

Ethical considerations regarding mice primarily revolve around their treatment in scientific research, including issues related to their welfare, use in experiments, and potential alternatives to minimize harm. Researchers must adhere to ethical guidelines to ensure the humane treatment of mice, minimize suffering, and use them only when necessary for valid scientific purposes. Additionally, efforts are made to reduce the number of mice used in experiments and to employ alternative methods, such as computer modeling or tissue cultures, whenever possible. These considerations aim to balance the benefits of scientific research with the welfare of the animals involved.

4. Experimental design

The design of experiments is the design of any task that aims to describe and explain the variation of information under conditions that are hypothesized to reflectthe variation. Some of the key factors related to experimental design for mice are,

- **Research question :** Clearly define the question your experiment aims to answer. This will guide all other aspects of your design.

- **Hypothesis :** Formulate a hypothesis based on your research question. This will help you determine the variables to measure.
- **Experimental groups :** Decide on the number and composition of experimental groups. Typically, this includes a control group and one or more treatment groups.
- **Sample size :** Determine the number of mice needed per group to achieve statistical significance. Consider factors such as variability, effect size, and ethical considerations.
- **Randomization :** Randomly assign mice to different experimental groups to reduce bias and ensure that each group is representative of the overall population.
- **Blinding :** Consider whether blinding is appropriate to minimize bias. This could involve blinded allocation of treatments, data collection, or data analysis.
- **Treatment protocol :** Define the treatment protocol for each experimental group, including dosage, duration, and frequency of administration.
- **Outcome measures :** Choose appropriate outcome measures to assess the effects of the treatments. These could include biochemical assays, behavioral assessments, or histological analyses.
- **Data collection :** Determine how data will be collected, recorded, and analyzed. Ensure that procedures are standardized and reproducible.
- **Ethical considerations :** Ensure that the experiment complies with ethical guidelines for the use of animals in research. This includes minimizing pain and distress, obtaining ethical approval, and following relevant regulations.

5. Data consideration of mice

Collecting data on mice typically involves several methods depending on the specific research goals. These methods can range from simple self-repported surveys to complex experoments which involve both the qualitative and quantative value for the required data. These are some common methods.

- **Observational studies :** Observing mice in their natural habitat or controlled environments to gather behavioral data.
- **Experimental studies :** Conducting experiments where mice are exposed to different conditions or treatments, and their responses are measured.
- **Biological sampling :** Collecting biological samples such as blood, tissue, urine, feces, or saliva for molecular, genetic, or biochemical analysis.
- **Behavioral testing :** Using various behavioral tests such as maze tests, open-field tests, and fear conditioning to assess cognitive and emotional functions.

- **Physiological measurements :** Recording physiological parameters like heart rate, blood pressure, body temperature, or respiratory rate using specialized equipment.
- **Genetic studies :** Genotyping mice to study genetic variations and their effects on traits or diseases.
- **Imaging techniques :** Employing imaging techniques like MRI, CT scans, or microscopy to visualize internal structures or organs and track changes over time.
- **Environmental monitoring :** Monitoring environmental factors such as temperature, humidity, light-dark cycles, and noise levels to understand their impact on mice behavior and physiology.
- **Longitudinal studies :** Following mice over an extended period to observe developmental changes, aging processes, or the progression of diseases.

Acts depend on mice :

Institutional Animal Care and Use Committees (IACUCs) are centrally important in applying laws about animal research in the United States. Most research involving laboratory animals in the United States is funded by the United States National Institutes of Health or, other federal agencies. Similar systems operate in other countries, but generally under different titles.

For example, in Canada a typical title would be the University Animal Care Committee (UACC), while in the United Kingdom it would be the Animal Welfare and Ethical Review Body (AWERB).

The NIH Office of Laboratory Animal Welfare (OLAW) has been directed by law to develop policies that describe the role of Institutional Animal Care and Use Committees. Every institution that uses certain animals for federally funded laboratory research must have an Institutional Animal Care and Use Committee (IACUC). Each local IACUC reviews research protocols and conducts evaluations of the institution's animal care and use, which includes the results of inspections of facilities that are required by law.

Responsibilities of IACUC

The IACUC is responsible for oversight of the animal care and use program and its components as described in the Public Health Service (PHS) Policy on Humane Care and Use of Laboratory Animals (Policy) and the Guide for the Care and Use of Laboratory Animals (Guide). Major responsibilities of IACUC which include:

- Review, at least semiannually, the institution's program for the humane care and use of animals.
- Inspect, at least semiannually, the institution's animal facilities (satellite facilities).

- Prepare reports to the Institutional Official (IO) of the IACUC evaluations.
- Review animal welfare concerns.
- Make recommendations to the IO on any aspect of the animal program, facilities, or personnel training.
- Review and approve, those components of PHS conducted or supported activities related to the care and use of animals.
- Review and approve, proposed significant changes to the use of animals in ongoing activities
- Be authorized to suspend an activity involving animals.

Common habites of mice:

- **Nesting:** Mice are known for their instinct to build nests using materials like shredded paper, cloth, or bedding. This behavior is essential for shelter and reproduction.
- **Foraging:** Mice are opportunistic feeders and spend a significant portion of their time searching for food. They have a keen sense of smell and will explore their environment in search of food sources.
- **Burrowing:** Mice are skilled burrowers and will create elaborate tunnel systems for shelter and protection from predators. This behavior is especially prominent in wild or outdoor environments.
- **Exploration:** Mice are curious creatures and will explore their surroundings, especially when introduced to new environments or objects. This behavior helps them adapt to changes in their environment.
- **Social behavior:** Mice are social animals and often live in colonies with complex social structures. They engage in behaviors such as grooming, scent marking, and communication through vocalizations.
- **Reproduction:** Mice have a high reproductive rate and can breed throughout the year under suitable conditions. They exhibit courtship behaviors before mating and females typically build nests for their offspring.

Understanding these habits is crucial for studying mouse behavior, ecology, and their impact on various ecosystems**.**

Factors affecting the habitats:

The habits of mice can be influenced by various factors including genetics, environment, social interactions, diet, and stress levels. Genetics play a role in determining certain behaviors, while environmental factors such as housing conditions and availability of resources can also

impact behavior. Social interactions with other mice can affect their habits, as can diet composition and availability. Additionally, stressors like loud noises or overcrowding can alter their behavior patterns. Understanding these factors can help researchers design experiments and interventions to study and modify mouse behavior. Several factors can affect the habitats of mice:

- **Food availability :** Mice are omnivorous and will adapt their habitat to access food sources, including seeds, grains, fruits, and insects.
- **Shelter :** Mice seek shelter in environments that provide protection from predators, extreme weather conditions, and disturbances. This could include burrows, dense vegetation, or human-made structures.
- **Water sources :** Access to water is essential for mice, so habitats near water bodies or areas with reliable water sources are favorable.
- **Temperature and humidity :** Mice prefer habitats with moderate temperatures and humidity levels, avoiding extremes that could be harmful to their survival.
- **Predators :** The presence of predators such as cats, birds of prey, snakes, and certain mammals can influence where mice choose to establish their habitats.
- **Human activities :** Human activities can significantly impact mouse habitats, including urbanization, agriculture, deforestation, and pollution. Mice often adapt to human-altered environments, leading to increased interactions and potential conflicts.
- **Competition :** Competition with other species for resources, such as food and shelter, can also shape mouse habitats. In some cases, dominant species may displace mice from preferred habitats.
- **Disease prevalence :** The prevalence of diseases, parasites, and pathogens in an area can affect mouse populations and their habitat preferences.

Understanding these factors is crucial for managing and controlling mouse populations, especially in areas where their presence poses risks to human health or agricultural protectivity.

Experimental knowledge about male mice :

Male mice are commonly used in experimental research due to their biological and behavioral similarities to humans, making them valuable models for studying various aspects of physiology, behavior, genetics, and disease. These experiments often aim to understand fundamental biological processes, investigate disease mechanisms, test potential treatments, or explore behavioral patterns. Male mice are preferred in many studies due to their hormonal stability compared to females, which can fluctuate during the estrous cycle, potentially

introducing variability in experimental results. Additionally, the genetic and physiological uniformity of inbred mouse strains facilitates reproducibility and comparability across experiments. Overall, male mice serve as essential tools in advancing our understanding of numerous scientific disciplines.

1. **Housing:** Mice are typically housed in cages with bedding material to mimic their natural environment. Proper temperature, humidity, and lighting conditions must be maintained to ensure their well-being.
2. **Experimental groups:** Mice are often divided into different experimental groups based on the variables being studied. This could include factors like diet, drug treatments, genetic modifications, or environmental exposures.
3. **Control groups:** Control groups are essential for comparison purposes. These mice are typically treated identically to the experimental groups except for the specific variable being studied.
4. **Randomization:** To minimize bias and ensure that the results are not influenced by external factors, mice are often assigned to different experimental groups randomly.
5. **Sample size:** The number of mice used in the experiment should be sufficient to yield statistically meaningful results. Sample size calculations are often performed to determine the minimum number of animals required.
6. **Data collection:**Various techniques are used to collect data, depending on the specific research question. This could include behavioral observations, physiological measurements, tissue sampling, or molecular analysis.
7. **Ethical considerations:** Animal welfare is of utmost importance in experimental research involving mice. Researchers must adhere to ethical guidelines and obtain approval from institutional animal care and use committees.
8. **Statistical analysis:** Once data is collected, statistical analysis is performed to determine if there are significant differences between experimental groups. This helps to draw conclusions and make inferences based on the results.

Overall, the experimental setup for studying mice in animal science is carefully designed to ensure the validity and reliability of the research findings while also prioritizing the welfare of the animal involved.

Experimental knowledge about Female mice:

Female mice are often used in experimental research due to their physiological and behavioral similarities to humans. In studies involving female mice, researchers aim to understand various aspects of biology, including reproduction, development, behavior, and

disease processes. These studies help shed light on fundamental biological mechanisms and provide insights into human health and disease. Additionally, female mice are utilized in preclinical drug testing and toxicology studies to evaluate potential treatments and assess safety profiles. Overall, the use of female mice in research plays a crucial role in advancing scientific knowledge and improving human health outcomes.

In animal science, experimental setups for female mice typically involve considerations such as housing conditions (group or individual), environmental enrichment, diet, and monitoring of reproductive status. Variables like age, strain, and genetic background are also crucial. Researchers often assess behavioral, physiological, or reproductive parameters, depending on the study's objectives. Additionally, ethical guidelines and regulations regarding animal welfare must be strictly followed throughout the experimental process.

In animal science research involving female mice, the experimental setup typically includes housing the mice in controlled environments with appropriate bedding, temperature, and lighting conditions to ensure their well-being. Researchers often utilize cages equipped with food and water access ad libitum. Depending on the study's objectives, female mice may undergo specific treatments, interventions, or observations. Monitoring parameters such as behavior, physiology, and reproductive outcomes are common. Ethical considerations, including minimizing distress and following regulatory guidelines, are integral to experimental design.

Conclusion:

In conclusion, understanding the policies and habits of mice is crucial in the field of animal science. By comprehensively examining their behavior, reproduction patterns, dietary preferences, and environmental needs, researchers and practitioners can develop effective strategies for pest control, laboratory experimentation, and conservation efforts. Moreover, recognizing the ethical considerations surrounding the treatment of mice in various contexts allows for the establishment of guidelines that prioritize their welfare while still advancing scientific knowledge. Overall, a nuanced understanding of mouse policies and habits serves as a foundation for responsible and ethical animal management practices, contributing to both scientific progress and the well.

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TRACEABILITY AND AUTHENTICATION OF PASHMINA PRODUCED BY CHANGTHANGI GOAT IN INDIA

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Abstract:

The Changthangi goat is a well-recognized breed, prized for its valuable Pashmina wool. Originating from the Changthang area of the Leh district in the state of Jammu & Kashmir, India, this breed thrives in the cold, arid agro-climatic conditions of the region. Situated adjacent to Tibet, the Changthang area provides an ideal environment for the Changthangi goat to flourish. These goats are primarily reared by a nomadic community known as the 'Changpa.' The Changpa have a deep understanding of the local environment and have been raising Changthangi goats for generations, utilising their wool for making Pashmina products such as shawls, scarves, and blankets. The adaptation of the Changthangi goat to the harsh climate of the region, combined with the expertise of the Changpa nomads in goat husbandry and Pashmina production, contributes to the high quality of Pashmina wool derived from these goats. This wool is known for its exceptional softness, warmth, and luxurious feel, making it highly prized in the textile industry. However, ensuring the authenticity and traceability of Pashmina products is essential to maintain consumer trust and support sustainable practices. Various methods encompass certification programs, labelling initiatives, documentation processes and In the laboratory, dye and chemical staining procedures, as well as spectroscopic, microscopic, molecular marker analysis, and DNA sequencing, are used to ensure that verify the origin and quality of genuine Pashmina products free from any prohibited fiber. Through these measures, consumers can confidently identify genuine Pashmina goods while supporting the livelihoods of local communities engaged in the traditional art of Pashmina production and preserving the integrity of Pashmina, safeguarding the interests of producers and consumers alike, and promoting ethical and sustainable practices within the industry.

Keywords: Pashmina, Changthangi goat, FTIR, PCR-RFLP, DNA barcode.

Introduction:

The specialty of animal fibers possesses unique qualities that set them apart from more common fibers. Their fineness, softness, and glossiness are unparalleled characteristics that make fabrics produced from these fibers highly valued. In which "Pashmina" is one of the most valued and sought-after luxury fibers in the world, known for its exceptional softness, warmth, and lightweight properties. Originating from the undercoat of the Chegu and Changthangi goats. The question now is who the Changthangi goat is, where she lives, what her significance is in Indian cultural heritage and how much it is worth economically. In India, primarily two goat breeds that produce pashmina, Chegu and Changthangi. Chegu breed was domesticated in the Kinnaur, Spitti and Lahaul region Himachal Pradesh and Uttarkashi, and Pithorgarh, Chamoli region of Uttarakhand where as Pashmina goat, often called Changthangi Goats, is scientifically identified as *Capra hircus,* native to the high-altitude Himalayan regions of Jammu & Kashmir. The Pashmina term is deeply culturally significant in the areas where it is painstakingly created, such as the Tibetan plateau and the villages of Kashmir. In European countries, Pashmina has served as a symbol of prestige. Pashmina fabric manufactured from changthangi goat hair not only holds smoothness and the greatest quality textile, but it also embodies the eternal spirit of artisanship. In other words The art of weaving is not only handmade craft but shows the emotion of people, because pashmina cloth symbolises monarchy and the opulent lifestyle of the queen and king. Worldwide China accounts for 70% of global fibre production, followed by Mongolia (20%), and remains from other nations like India, Nepal, Pakistan, Afghanistan, and Iran. Goats are used differently in different countries. For example, their skin is sometimes used as a meal by different people. However, nowadays, their shiny, smooth hair is used in luxurious fashion for things like shawls, sweaters, scarves, hats, gloves, mittens, earmuffs, and many other items. As a result, goat farming has increased in value and is a reliable source of income in colder climates.

Figure 1: (a) Pashmina wool (b) Pashmina shawls represents the culture of India

In opposite sex of changthangi goats have generally enormous, twisted horns, light brown and black. The ear is small, stumy, raised, and the neck is strong, whereas the face is small and triangular. In order to differentiate between male and female goats, the male forehead has tuft hair, while the female's matures more quickly than the male's and the female can conceive at six months of age. Male babies weigh more than female babies at birth, with the average mean weight of both sexes ranging from 1.82 to 2.25 kg.

Figure 2: (a) Adult Changthangi female goat (b) Adult Changthangi male goat

Why needs for authentication and traceability of pashmina:

The testing for genuine pashmina is desideratum of time and essential for several reasons:

1. Guaranteeing quality: Authenticating Pashmina ensures that consumers receive high-quality products made from genuine Pashmina wool and free from any prohibited fibres. This helps maintain the reputation and integrity of Pashmina as a luxury material known for its softness, warmth, and durability.

2. Preventing fraud: With the rising demand for Pashmina products, there is a risk of fraudulent practices such as blending inferior fibres i.e synthetic fibres with Pashmina or mislabeling non-Pashmina products as authentic. Authentication measures help prevent such fraud, protecting both consumers and the reputation of genuine Pashmina.

3. Supporting local communities: Traceability initiatives enable consumers to support local artisans and communities involved in Pashmina production, also helping in women empowerment. By purchasing authenticated Pashmina products, consumers contribute to the livelihoods of these artisans and help preserve traditional craftsmanship and heritage.

4. Ensuring ethical sourcing: Traceability allows for the verification of the source of Pashmina wool, ensuring that it is obtained ethically and sustainably. This includes considerations such as animal welfare and environmental sustainability in Pashmina production areas.

5. Compliance with regulations: Authentication and traceability measures help companies comply with regulations related to labelling and consumer protection. By accurately labelling

Pashmina products and providing transparent information about their origin, companies adhere to regulatory standards and build trust with consumers.

Methods and techniques for traceability and authentication:

1. Chemical composition analysis: Chemical analysis methods, such as infrared spectroscopy (FTIR), nuclear magnetic resonance (NMR) spectroscopy, and mass spectrometry, are employed to analyse the chemical composition of Pashmina wool. These techniques can help identify any additives or impurities present in the wool and ensure its purity and authenticity. Details and explanations for (FTIR) spectrometry provided below-

Fourier Transform Infrared Spectroscopy (FTIR) Spectrometry: The study of interactions between matter and electromagnetic fields in the infrared (IR) region, where EM waves couple with molecular vibrations, is one application of infrared (IR) spectra. Molecules in the infrared area absorb infrared radiation and become excited.

IR spectroscopy is an extremely potent technology that offers quantitative and qualitative fingerprint information on the chemical composition of fibre samples. In FTIR spectroscopy, the interferogram is determined experimentally. The spectrum is displayed against the corresponding wavenumber and the transmittance values. Infrared spectroscopy yields a positive identification (qualitative analysis), and the magnitude of the peaks in the spectrum directly relates to the amount of material present.

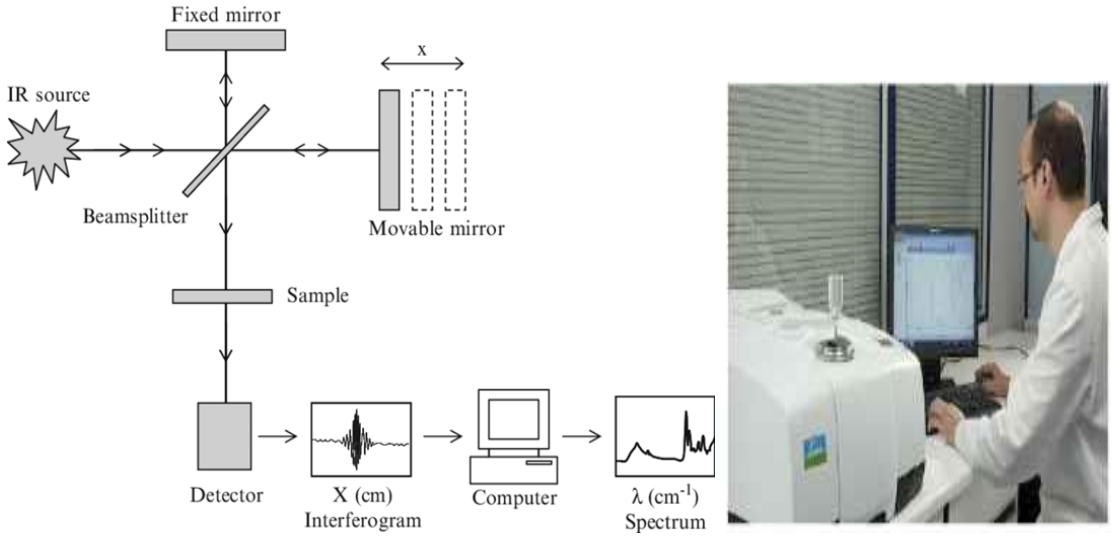

Figure 3: Diagramatic representation and Instrumentation of FTIR technique

2. Fibre analysis: Microscopic analysis and fibre identification techniques are used to examine the structure and characteristics of Pashmina fibres. This helps in distinguishing genuine Pashmina wool from other fibres and assessing the quality and fineness of the wool.

Details and explanations for microscopic analysis (quantitative) provided below-

Microscopic analysis (quantitative) of Pashmina: There are two popular techniques for quantitative Pashmina analysis: optical and scanning electron microscopy. Through the use of an optical microscope, magnified Pashmina fibres can be identified by looking at surface features such as scale structure The textile analysis of pashmina fibre was identified using the AATCC-20A and ASTM-D629 procedure.

Electrons are used by scanning electron microscopes (SEMs) to image fibre surface properties. SEM solutions give a greater resolution and larger depth of field to capture fibre surface features, while the fibre is usually coated with a thin layer of gold to display the scanned surface. In contrast to optical microscopy, SEMs cannot catch interior fibre structure and colouring.

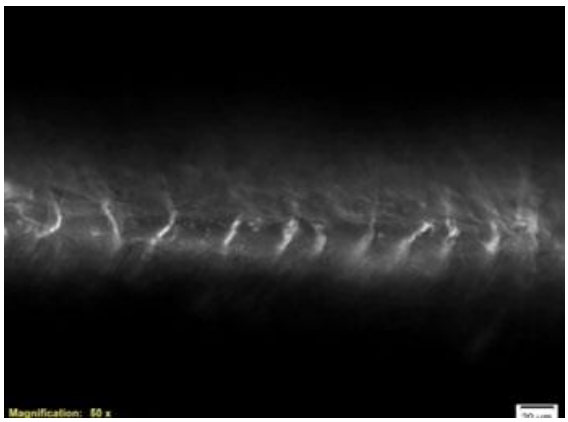

Figure 4 (a): Optical microscope shows the fiber

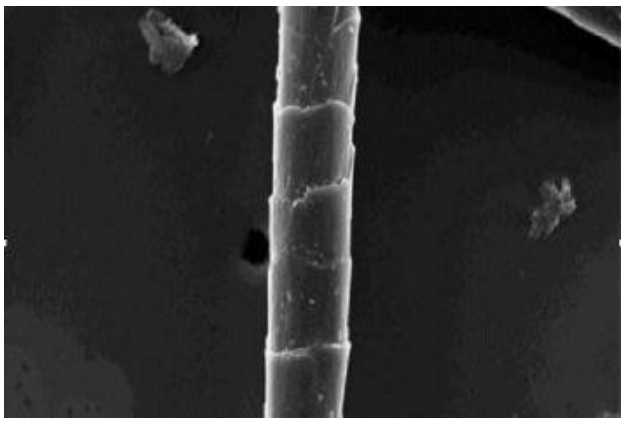

Figure 4 (b): Scanning electron microscope shows the fiber

3. Molecular marker analysis, **DNA fingerprinting, and isotopic analysis:** These techniques are utilised to establish the authenticity and traceability of Pashmina products. These techniques can trace the origin of Pashmina wool back to specific geographical regions or herds of Pashmina goats, providing assurance to consumers and supporting fair trade practices.

4. PCR based methods: PCR-based methods, such as DNA amplification strategies, allow for the identification of species-specific animal fibres like cashmere/cashgora, fine wool, yak, and camel hair in both treated and untreated fibre samples, including blends. This technology enables precise differentiation between various types of animal fibres, even in complex mixtures, by targeting specific DNA sequences unique to each species. The restriction fragment length polymorphism (PCR-RFLP) approach is most effective for distinguishing between pashmina fine wool fibres. The RFLP technology, which detects the presence of DNA in animal hair shafts, has permitted the separation of DNA from pashmina and fine wool fibres. DNA analysis can also differentiate these fibres in the raw condition.

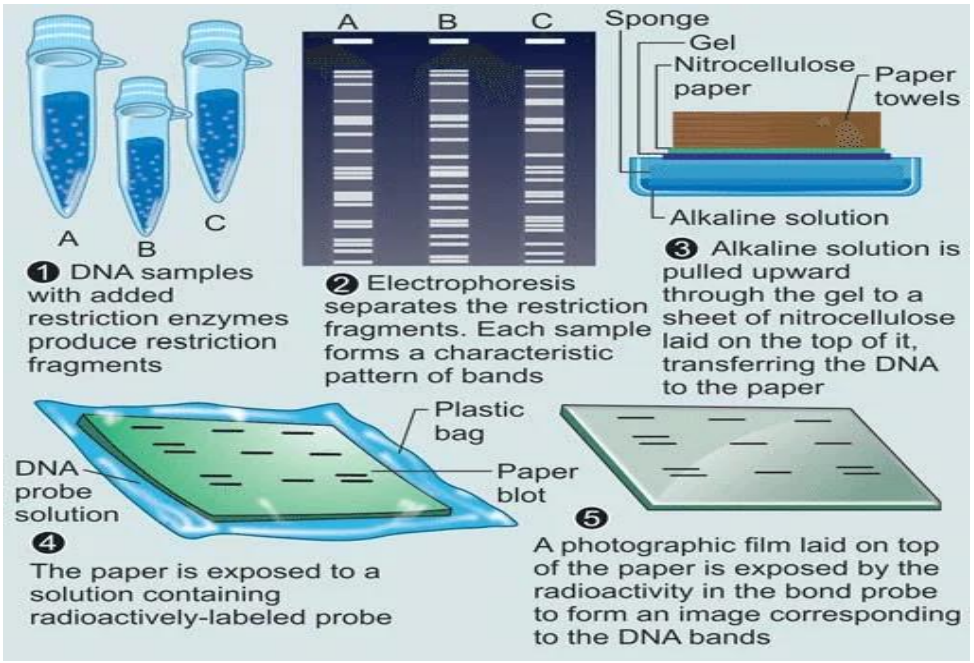

Figure 5: Flow chart of the restriction fragment length polymorphism (PCR-RFLP)

5. DNA barcode methods: The COX I gene sequence, approximately 650 base pairs long from the 5' end, is highly conserved yet contains abundant mutation sites, earning it the moniker "DNA barcode." This designation has widespread use in species identification and classification (Hebert, Ratnasingham, and deWaard 2003) and (Rabie 2019). This genetic barcode offers both theoretical and material foundations for identifying species, even in unique samples like animal fibres.

6. Noval microchip-based real-time PCR: The novel microchip-based real-time PCR technology appears promising for identifying and quantifying cashmere and wool content in fibre mixtures, such as in cases of wool adulteration with cashmere. The data gathered from various cashmere samples sourced from different regions and goats of varying ages supports the reliability of this technology. Conducted in 1.2 µl reaction volumes within metal micro-reactors, the test offers cost-effectiveness, high specificity and sensitivity, reduced human error, and minimal false negative or false positive rates.

7. Chemical staining method: To distinguish between pashmina fibre and fine wool, the wool/pashmina fibre is stained with phosphotungstic acid and then magnified in a transmission electron microscope. Pashmina fibre has a spectrum of structures from typical bilateral to non-bilateral, whereas fine wool contains bilateral ortho and para cortex.

8. Dye analysis: Chromatographic and Spectroscopic methods are used to analyse dyes and colourants used in Pashmina textiles. This helps in verifying the authenticity of dyed Pashmina products and detecting any unauthorised or harmful dyes. With expanding the product range and

enhancing value through techniques like dyeing, embroidering, and blending pashmina with lower-cost fibres such as wool could address the challenges posed by high processing costs and limited variety. Blending, in particular, offers an opportunity to improve performance and lower costs simultaneously by combining fibres with complementary properties.

9. TLC and HPLC Chromatography techniques: These methods of separation are crucial to the qualitative and quantitative examination of diverse dye mixes derived from distinct matrices.

Using chromatographic techniques to analyse textile dyes requires removing the dyes from their enclosing matrix, altering the dispersion medium, and pre concentrating the target dyes to a concentration level appropriate for chromatographic analysis. Solvent extraction, solid-phase extraction (SPE), and ultrasound-assisted extraction (USAE) are the three most widely utilised extraction techniques. The kind of textile dyes used and the matrix structure they are enclosed in determine the appropriate chromatographic techniques and extraction conditions.

10. 2D-PAGE (two-dimensional polyacrylamide gel electrophoresis): This approach, which uses an alkaline gel in the first dimension and SDS in the second, can distinguish pashmina fibre from other goat hair. As a result, buyers simply determine whether the desired product is real or not and products are what I require. These methods also included the Soxhlet extraction for the amount of sterol and fatty acid from different animals.

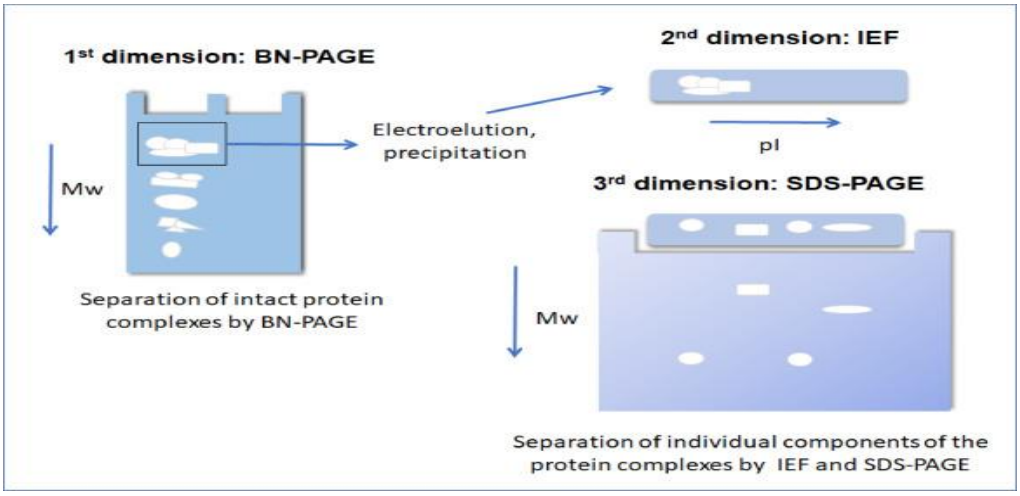

Figure 6: Graphical representation of 2D gel electrophoresis

11. Physical testing: There are both genuine and fraudulent products on the market, but the question of how consumers may make sure that the thing is genuine and symbolises its value when worn has come up. Although numerous chemical and molecular techniques have been developed to reliably distinguish between authentic and counterfeit goods, chemical techniques are not cost-effective or time-efficient, hence physical techniques were employed instead.

The original Pashmina scarf is soft and hypoallergenic, meaning it won't trigger an allergic reaction, and due to the tiny diameter of its fibres, it is typically as soft and smooth as butter, not straight and bumpy, If it is transparent, it is not genuine Pashmina, as it does not transmit light. Even while synthetic fibres produce a lot of static electricity and tiny sparks when they brush against one another, Pashminas exhibit none of these properties, so there you have it—instant evidence!

Figure 7: Burning and Rubbing test of Pashmina fibre produced by Changthangi goat

Physical testing methods, including tensile strength testing, abrasion resistance testing, and pilling resistance testing, are conducted to assess the durability and performance of Pashmina textiles. These tests help determine the suitability of Pashmina products for various applications and ensure they meet quality standards.

12. Quality control: Quality control measures, such as moisture content analysis, yarn count determination, and colour fastness testing, are implemented to monitor the production process and ensure consistency and uniformity in Pashmina products. This helps maintain high standards of quality and reliability in the industry.

Role of Wildlife Institute of India (Pashmina Certification Centre) in testing:

The Wildlife Institute of India (WII) plays a key role in testing Pashmina to ensure its authenticity and quality. The purpose of establishing this Pashmina Certification Center (PCC) is to enhance the efficiency of the Pashmina trade by offering a centralised testing facility. This ensures that Pashmina products are certified free from any prohibited fibres, providing assurance to manufacturers, exporters, and traders. Each tested product will receive a unique ID tag and an e-certificate, facilitating seamless trade in both national and international markets.

Conclusion:

Changthangi goats are generally domesticated, survive on the grass in Ladakh, where temperatures can drop as low as −20°C (−4.00°F), provide the wool for Kashmir's well-known pashmina shawls, that result in it ensuring the place in prized species and play the role in the

Indian economy. Pashmina has a centuries-long history of attracting kings, royals, and people around the world with its enchanting charm and traditional grace. Because of its great demand, there is a high risk of black marketing of pashmina and its wool, thus authentication of pashmina wool is not only required, but the awareness of buyers is essential so that the original pashmina shawl is first position in tradition. Purpose of this chapter is Traceability and Authentication of pashmina wool only to enhance the quality of product and would also reduce the vulnerability of both consumers and producers Here we list all of the factors that make it simple to determine whether the product is genuine or not. Physical tests, such as smelling after burning a short thread, having no allergic reaction after wearing, and not producing electricity, establish the authenticity of pashmina wool. In the laboratory, dye and chemical staining procedures, as well as spectroscopic, microscopic, molecular marker analysis, and DNA sequencing, are used to ensure product quality and prevent any form of illicit activity.

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CONTRIBUTION OF ANIMALS DIVERSITY IN THE AGRICULTURE SECTOR

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Abstract:

The role of animals in sustainable agricultural practices is often overlooked, they play a vital role in the health and productivity of ecosystems. They help to control pests' diseases, and improve crop yields. Animals can provide important agricultural services like pollination, soil aeration, nutrient cycling, supplying milk, meat, eggs, wool, bullocks etc. and play an important role in the rural economy. India is an agrarian economy and farmers are the backbone of the economy. Animal husbandry is the backbone in the economy of farmers. Possession of livestock was a symbol of progress and prosperity of which could be quoted from *Vedas* and *Puranas*. Many farmers around the world depend on animals for their livelihood. Thus, the fauna diversity plays an important role in maintaining the economy of the farmer and our country. This paper focuses on the role of faunal diversity for the agricultural sector.

Keywords: Animal Diversity, Agriculture Sector

Introduction:

Agriculture is the art and science of cultivating the soil, growing crops, and cultivation of livestock of animals. This sector encompasses crop and livestock production, aquaculture, fisheries, and forestry for food and non-food bye-products. Agriculture sustains life, supports economies, and connects us to the land. The history of agriculture in India dates back to the Neolithic period. India ranks second worldwide in farm outputs. As per the Indian economic survey 2020-2021, agriculture employed more than 50 percent of the Indian workforce and contributed 20.2 percent to the country's GDP. Research studies have shown that animal fauna plays a significant role in crop cultivation and the overall health of ecosystems. Many farmers from various countries depend on animal husbandry for their livelihood. In addition to supplying milk, meat, eggs, wool, their castings and hides, animals, mainly bullocks, are the major source of power for both farmers and dairies. Studies have been shown that animal husbandry plays an important role in the rural economy. India is an agrarian economy and farmers are known as the backbone of the economy. Animal husbandry is the backbone in the economy of farmers. The Indian livestock sector is one of the largest in the world with holdings of 11.6 percent of the

world (BAHS, 2014). However, several studies have argued that a high abundance of managed bee pollinators, such as honeybees (*Apis mellifera*), may be sufficient to provide pollination services for crop productivity, and sociological studies indicate that the majority of farmers worldwide do not recognize the contribution of wild pollinator diversity to agricultural yield (Daniel *et al.*, 2022). Arthropods in soil act as "driving variables" indirectly affecting pathways of energy transfer in soil at level contributions to nutrient and energy fluxes (Anderson 1988). In addition to the arthropod fauna, other soil organisms ranged from the myriad of invisible microbes, bacteria and fungi to the more familiar macro fauna such as earthworms, beetles, centipedes, termites etc. These diverse organisms interact with one another with the various plants and animals in the ecosystem forming a complex web of biological activities. Many farmers around the world depend on animal for their livelihood. Thus, animal fauna plays an important role in maintaining the economy of the farmer and our country.

Discussion:

Agriculture includes cultivation of the soil, growing and harvesting crops, breeding, raising livestock, dairying, and forestry. Modern agriculture depends on engineering and technology and biological and physical sciences. Worldwide, the Food and Agriculture Organization (FAO) estimates that there will be a 73 percent increase in meat, egg and other products consumption and a 58 percent increase in dairy consumption over 2011 levels by the year 2050 (McLeod, 2011). Aquaculture also critically contributes to the world's food supply, and demand continues to increase as incomes rise. The FAO reports that over the past five decades, the world fish food supply has outpaced global population growth and has come to constitute an important source of nutritious food and animal protein for much of the world's population (FAO, 2014). The floral fauna provides food and habitat to beneficial insects and birds that pollinate them and manage pests. Livestock can recycle leftover parts of crops and provide natural fertilizer to fields and pasture through manure.

The bacterial diversity enhances services

The diversity of bacterial fauna plays an important role in enhancing services for sustainability of agriculture. Research studies have shown that soil inhabiting bacteria are integral to global biogeochemical cycles and influence nutrient cycling and mineral solubilization important to soil health, and crop productivity. Soil bacterial fauna directly impact planet fitness as pathogens, beneficial mutualists, and indirectly as decomposers or through antagonistic activity against plant pathogens (Noah, 2014). The beneficial bacteria have the capacity to produce plant hormones and induce systemic disease resistance response in plants. Agriculturally important microorganisms are envisaged to play important roles in various

measures to raise a healthy and remunerative crop, including integrated nutrient management, as well as disease and pest management to cut down agrochemicals without compromising the agricultural production (Amruta Gupta *et al.*, 2022). Research findings focused on the environmental benefits; a recurring problem associated with organic management is the unsatisfactory yield. A possible solution may rely on the soil microbiome, which presents a crucial role in the soil system.

The role as pollination services

Pollination is the transfer of pollen from the stamens to the ovule-bearing organs or to the ovules themselves. Pollination is essential to the production of fruit and seed crops. Studies have shown that 80 percent of the 1400 crop plants grown around the world require pollination by animal fauna. Pollinating agents can be animals such as insects, for example beetles or butterflies; birds, and bats; water; wind; and even plants themselves. Pollinating animals travel from plant to plant carrying pollen on their bodies in a vital interaction that allows the transfer of genetic material critical to the reproductive system of most flowering plants. Birds, bats, bees, butterflies, beetles, ants, and other small mammals that pollinate plants are responsible for bringing us one out of every three bites of food. Pollinators also sustain our ecosystems and produce our natural resources by helping plants reproduce. The economic value of animal pollination to world agriculture has been estimated to be 200 billion US dollars per year. More than 100000 various animal species play roles in pollinating the 250000 kinds of wild flowering plants on the planet (Dharam, 2012). Plant-pollinator interactions are valued mutualisms in agricultural food production and provide indispensable ecosystem functions that support global biodiversity (Ollerton, 2017). It is estimated that 87.5% of flowering plants depend on animal pollinators for reproduction (Ollerton *et al.*, 2011). In agriculture, 87 of the leading global food crops and 35% of global production volumes from crops are dependent upon animal pollination (Klein *et al.*, 2007). Biodiversity loss during the Anthropocene is a serious ecological challenge. Pollinators are important vectors that provide multiple essential ecosystem services but are declining rapidly in this changing world (Daniel, 2022).

The bye-products of animals

In the agricultural sector the livestock provides essential proteins and nutrients but also plays an important role in utilization of non-edible agricultural by-products. It also provides raw material byproducts such as hides, skin, blood, bone, wool, hair fat etc. Leather is the most significant product with a large export potential and is employed for various purposes in reception and abroad. Animal dung, urine and other waste materials provide organic manure/fertilizer to the crop subsector, dung used as bedding, plastering material and domestic

fuel. Meat and meat products form an important segment of the human diet because they provide essential nutrients which cannot be easily obtained through vegetables and their derived products (Byers *et al.,* 2002). They provide a means for reducing malnutrition and increasing household food and food security (Chikwanha *et al.,* 2017).

The role of livestock in economic development and poverty reduction

Around the world agriculture provides a livelihood for more people than any other industry. The growth in agricultural production and productivity raises rural incomes, increasing numbers dependent on the industry and to meet the food and raw material needs of the faster growing population. Enhancing agricultural productivity contributes to industrial growth by providing cheap labour, capital investment, foreign exchange and markets for manufactured consumer goods. India has the world's largest livestock population accounting for over 37.28 per cent of cattle, 21.23 per cent of buffalo, 26.40 per cent of goats and 12.17 per cent of sheep (Sonavale *et al.,* 2020). According to research, livestock wealth in the world comprises about 195 million buffaloes, 1482 million cattle, 1006 million goats, 1209 million sheep, 58.9 million horses, 10 million mules and 27.8 million camels (Ramachandra 2014; Senthilkumar, 2016).

The industrialization of livestock and agriculture

Livestock culture or animals raised in an agricultural setting in order to provide labour and produce diversified products for consumption such as meat, eggs, milk, fur, leather, and wool etc. the animals who are raised for consumption, and sometimes used to refer solely to farmed ruminants, such as cattle, sheep, and goats. Fishes are also cultured for ornamental, sports, flesh and various fish by-products. The distribution of the livestock population across the globe shows that the ruminants, cattle and sheep dominate the animal population in Asia, Africa and Oceania. About 97 percent of the world's total livestock populations are in Asia (Verma & Mandal, 2011). The livestock sector's ability to reach into many different areas of the economy and society, such growth represents a major development opportunity for many countries. Livestock production makes a major contribution to national economies worldwide (FAO, 2018). The value of global livestock production in 2013 has been estimated at 883 billion dollars, (constant 2005–2006 dollars) (FAOSTAT, 2016). Livestock plays an important role in the Indian economy. About 20.5 million people depend upon livestock for their livelihood. Livestock contributed 16% to the income of small farm households as against an average of 14% for all rural households. Livestock provides livelihood to two-third of rural communities. It also provides employment to about 8.8 % of the population in India. India has vast livestock resources. Livestock sector contributes 4.11% of GDP and 25.6% of total Agriculture GDP (vikaspedia). Studies have shown that livestock plays an important role in the economy of

farmers. Farmers in India composite farming system i.e. a combination of crop and livestock using natural resources from the farm.

Conclusion:

This research paper aims to provide a depth of the faunal diversity in providing various services in the agricultural sector. It sheds light on the complex relationship between the livelihood and farmer economy. The livestock have the ability to reach in many different areas of the economy and society for many countries. According to FAO faunal livestock production has a major contribution to the national economies worldwide. In India livestock plays an important role and about 20.5 million people depend upon this business. It contributes 16 percent income to the small farm households and average of 14 percent for all rural households. So small towns and urban spaces have opportunities for diversifying economic portfolios leading to greater income from faunal diversity for the agricultural sector.

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A GENERAL ACCOUNT OF FISH *LABEO ROHITA*

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Abstract:

Fish and fish products contribute significantly for protein supply in the world. Over millions of people depend on fishes as a main source of animal protein worldwide. In India, aquaculture is considered as a sunrise sector. A large number of livelihoods are supported by aquaculture in India and Indian subcontinents. India is home to more than 10% of global fish biodiversity. The major carp species cultivated in India are namely *Catla catla*, *Labeo rohita*, *Cirrhinus mrigala*, *Exotic carp*, *Grass carp* and *Common carp. Labeo rohita* commonly known as Rohu is a fresh water major carp species found in rivers and ponds. It is a major carp species dominantly cultured and also contributes a large portion to total inland fish production in India. They are geographical distributed along temperate & tropical regions like India, Nepal, Vietnam, Myanmar, Bangladesh and Pakistan. *Labeo rohita* is a very rich source of protein and have very high nutritive values. It has high demand in market and highly priced food fish due to its delicious flavor and non fishy smell. Labeo rohita has great commercial value and also economically important.

Keywords: *Labeo rohita*, Indian Major Carp, Animal protein

Introduction:

Fisheries in India is a very important economic activity and a flourishing sector with varied resources and potentials. Only after the Indian Independence, has fisheries together with agriculture been recognized as an important sector (FAO). The growth in the fish farming sector mainly comes from the freshwater aquaculture sector, as marine finfish culture is hardly practiced on a large scale. About 12.8 percent of total animal protein consumed in India comes from freshwater fish (Vijay Anand, 2019).

India is the second largest aquaculture fish producer and third largest fish producing country in the world. India contributes about 7 % to the global fish production. Around 70% of India's fish production comes from inland waters. Out of total aquaculture production, Indian Major Carps are the most cultured fresh water fish. Fish and fish products contribute significantly for protein supply in the world. As a main source of animal protein, millions of people depend on fishes worldwide. Fish food from fish farm as well as catch fisheries offers one

of the easiest and fastest way to address malnutrition and food security. There is major role of fish in human nutrition in India, especially for people living in coastal areas. Indian fisheries and aquaculture are key food-producing sectors that provide nutritional security to the food basket, contribute to agricultural exports, and employ approximately 14 million people in various activities (Dhillon *et al.,* 2018).

Fishes belonging to the family Cyprinidae of class Osteichthyes are called Carps. Carps are toothless fishes having cycloid scales on the body. The major carp species cultivated in are namely *Catla catla, Labeo rohita, Cirrhinus mrigala, Exotic carp, Grass carp* and *Common carp*. These fishes are found on low trophic level and hence it is possible to culture these fishes on natural food.

India has a tremendous potential for the growth of fish-based industries and presently one of the focus sectors is fish production, marketing and consumption. The demand for fish is ever increasing because of its nutritive value being a rich source of protein. In India, the major carps Catla *(Catla catla)*, Rohu *(Labeo rohita)* and Mrigal *(Cirrhinus mrigala)* are the mainstay of freshwater aquaculture. The major carps are the most preferred farm fishes because of their fast growth and higher acceptability to consumers. The natural genetic resources of Indian major carps come from the network of the Ganga River system, the Sindh and the Brahmaputra River systems in the north and the east-coast and west coast river systems flowing through in the south and central India respectively. The major carps of India fall under three genera namely Catla, Labeo and Cirrhinus. Due to their fast-growing nature and taste Indian major carps enjoy a prime position in the Indian aquaculture scenario (Bais, 2018).

***Labeo rohita* (Hamilton, 1822)**

Labeo rohita is a freshwater major carp mostly found in rivers and ponds. It is one of the major carp species which is dominantly cultured and also contributes a huge portion top the total inland fish production in India. *Labeo Rohita* is common in North India, Orissa and Bengal and is called Rohu but in Assam it is known as (Bais, 2018).

As *Labeo rohita* breeds in riverine ecosystem, its ready seed availability has helped in establishing its aquaculture in the peripheral region of the riverine system in these countries. *Labeo rohita* has a great food valve since its flesh is rich in proteins and minerals. It is commonly consumed as food in India, Bangladesh, Nepal and Pakistan. In normal cultural conditions, Rohu can reach up to 35 to 45 cm in total length and can gain nearly 700 to 800 g weight in one year.

Geographical distribution:

Labeo rohita is geographically distributed along temperate and tropical regions like India, Nepal, Pakistan, Vietnam, Myanmar and Bangladesh. It mostly breeds in rivers and bund types

of tanks but does not breed in confined waters. *Labeo rohita* is a eurythermal species. It does not thrive at temperature below 14^0C. *Labeo rohita* is found in in rivers throughout most of central India, eastern India and northern India. Rohu is abundantly found in ponds and rivers. This carp is generally vegetarian and bottom feeders whereas occasionally feed on animal diet.

Taxonomic position:

Phylum	-	Vertebrata
Sub phylum	-	Craniata
Super Class	-	Ganthostamata
Class	-	Teleostomi
Sub Class	-	Actinopterygii
Sub Order	-	Cyprinoidei
Family	-	Cyprinidae
Genus	-	Labeo
Species	-	*Labeo rohita* (Hamilton 1822)

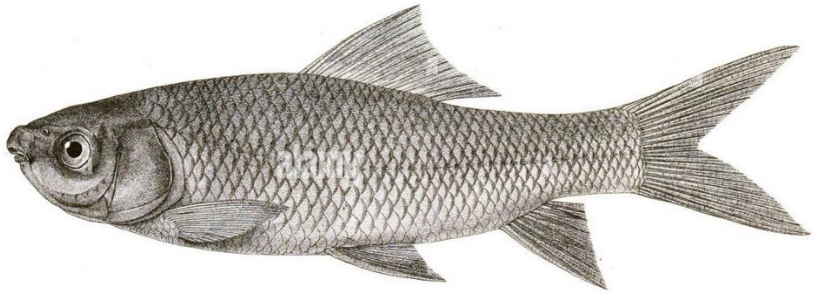
Related taxa:

Labeo rohita is found in most of the places in India and hence it has different local names in the different regions some of which are mentioned below.

State	**Name**
Maharashtra	Rohu
West Bengal	Rohu, Ruee
Assam	Rau, Rohiti, Rohitii
Gujarat	Rohu
Hindi	Rohu
Orissa	Rohi, Rohu
Punjab	Dhambra, Dumra
Tamil Nadu	Rohu
Kerala	Rohitham
Karnataka	Rohu

Morphology:

- Body of *Labeo rohita* is compressed, fusiform, bilaterally symmetrical and moderately elongated.
- The body measures about 1 meter in length and weight is about 4 kg.
- Body colour of Rohu is bluish or brownish on back and silvery white on flanks and belly. Body shows dorsal fin, caudal fin, anal fin, paired pectoral and anal fin with presence of soft fin rays.



- Caudal fin is forked into equal lobes
- Mouth does not contain teeth. Teethes are present only in pharynx, in three rows.
- Body is arranging into head, trunk and tail.
- Head is depressed devoid of scales; snout is fairly depressed which is projecting beyond mouth without lateral load. Snout bears sub terminal fringe lipped mouth bounded by fleshy upper and lower lips. It also contains paired nostrils and paired eyes.
- Eyes are dorsolateral in position and not visible from outside of head.
- A paired filamentous barbles arise from upper lips. Small tubercles cover the snout which is oblong, depressed, swollen and projecting beyond the jaws.
- Lateral line is distinct, overlayed by cycloid scales.
- Body is covered with cycloid scales. The scales are flat, bony with rounded edges and have great taxonomic importance. These scales overlap and forms a complete covering around the body.

Fin formula:

D. 15-16 (3/12-13); P_1. 16-17; P_2. 9; A. 7(2/5). Rahman (2005)

Color:

Body colour of Rohu is bluish or brownish along the back and silvery on the sides and beneath. A red mark is usually present on each scale.

Maturity:

The minimum age at first maturity for both sexes is two years, while complete maturity is reached after four years in males and five years in females. In captivity with proper feeding the species attains maturity towards the end of second year (FAO).

Reproduction:

Mode of reproduction in Rohu is dioecism. Fertilization is external. In nature, spawning occurs in the shallow and marginal areas of flooded rivers. The spawning season of Rohu generally coincides with the south-west monsoon, extending from April to September. However, breeding does not take place in such lentic pond environments; thus, induced breeding becomes necessary (FAO). The frequency of spawning is one clear seasonal peak per year. Parental care is not seen. Spawns in middle reaches of rivers, where flood water spreads in more or less, limpid

shallows over fertile flats, well above tidal reaches also in reservoirs and bundh-type tanks Khan, H.A. and V.G. Jhingran (1975).

Fecundity:

The fecundity varies from 226 000 to 2 794 000, depending upon fish size and ovary weight; on average it ranges from 200 000-300 000 eggs/kg BW. Rohu is a polygamous fish and also seems to be promiscuous. The optimum temperature for spawning is 22-31°C (FAO).

Food and feeding habit:

Feeding intensity varies with size, the reproductive cycle, season and environment. Both the males and females feed well when they are immature and there is considerable increase in the feeding intensity as they progress to the maturing stages. In the mature stages, there is reduction in feeding. After spawning, the spent fishes again start feeding actively. This increase and decrease is more prominent in females than males Khan and Jhingran (1975). During the fry stage rohu is predominantly a planktivorous surface feeder. From the fingerling stage onwards the feeding habit changes and the fish feed in the water column and on the bottom, mainly on filamentous algae, decomposed vegetation, mud and sand Chondar, (1999). The food of *Labeo rohita* consisted of plant (algae and macrophytes) and animal matter (protozoa, rotifers, cladocerans, copepods, molluscs, annelids and insects) besides unidentified matter (UM), sand/mud and detritus Yahya Bakhtiyar *et.al.,* (2007). *Labeo rohita* is known as water column feeder which feeds on plankton. In the juvenile and adult stages rohu is essentially an herbivorous column feeder, preferring algae and submerged vegetation. Under natural condition, in fingerling stage, it prefers zooplankton, with phytoplankton as subsidiary food. At this stage it exhibited a strong positive selection for all zooplanktonic organisms and smaller phytoplankton. Adults show a strong negative selection for all zooplanktonic organisms and positive selection for most phytoplanktonic organisms. However, in periphytic environment, it ingests sub-periphytic organisms present in proximity to substrate Sandip Majumder *et al.* (2018).

Nutrient requirement of fish *Labeo rohita*:

The major nutrient requirements of rohu are summarized in Table 1, 2 and 3 (FAO)

Table 1: Crude protein requirement

Life stage	**Requirement (%)**
Larvae	35-45
Fry	35-45
Fingerling	30-40
Juvenile	30-35
Grower	25-30
Brood stock	25-30

Table 2: Essential amino acid (EAA)requirement

EAA	% of protein	% of diet
Arginine	5.75	2.30
Histidine	2.25	0.90
Isoleucine	3.00	1.20
Leucine	3.75	1.50
Lysine	5.68	2.27
Methionine	2.88	1.42
Phenylalanine	4.00	1.48
Threonine	4.28	1.71
Tryptophan	1.13	0.45
Valine	3.75	1.50

Table 2: Crude lipid, essential fatty acid (EFA) and energy

Nutrients	Life stage/size class	
	Fry	Fingerling
Crude lipid, % min	5 - 15	5 - 15
Essential fatty acids, % min*		
Phospholipid, % min	4	4
Carbohydrate, % max	45	35 - 40
Metabolizable energy (kcal/100g)		379.7 - 400.0
Protein to energy ratio, mg/kcal	113	95.0-107.8

Economic Importance of *Labeo rohita:*

Labeo rohita is one of the fastest growing major carp species and considered as one of the most valuable food fish which is mostly cultivated in fresh water ponds, lakes and tanks. This fish is fleshy, valued high in market and is noted especially for its delicacy. It is highly preferred for consumption not only due to its high levels of nutrition but also due to its delicate flavor. This fish have smooth texture, not oily and have pleasant non-fishy taste which makes it quite sought after. Rohu is rich in proteins, Omega 3 fatty acids, vitamins A, B, C and low in fats.

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UNDERSTANDING THE UDDER'S ENEMY: BOVINE MASTITIS

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Abstract:

Bovine mastitis, an inflammation of the mammary gland in dairy cattles, poses a significant threat to milk quality and cattle health. It is characterized by altered milk quality and an increase in somatic cell count, mastitis is primarily caused by infectious agents like *Streptococcus agalactiae*, *Escherichia coli* and *Staphylococcus aureus* etc. Early diagnosis through milk screening tests is crucial, and treatment involves targeted antibiotics and vaccination. The impact on milk quality, coupled with ongoing research into preventive measures like Herbal Treatment or nutraceuticals, underscores the importance of effective mastitis management in the dairy industry.

Keywords: Bovine mastitis, *Streptococcus agalactiae*, Antibiotic therapy, California Mastitis Test (CMT), Nutraceuticals

Introduction:

Mastitis, a term originating from the Greek words "mastos" (breast) and "itis" (inflammation), refers to the inflammation of the mammary gland, most commonly affecting dairy cows. This condition is characterized by a complex interplay of physical, chemical, and bacteriological changes within the affected gland, ultimately impacting milk quality and animal health.

One of the hallmarks of mastitis is the alteration of milk composition. This includes a significant increase in the somatic cell count (SCC), which serves as a marker for inflammation and potential infection. Healthy cows typically have an SCC below 200,000 cells/ml, whereas mastitis can elevate this count to over 2 million cells/ml. Additionally, chemical changes in the milk composition can occur, affecting its taste, texture, and nutritional value. In severe cases, the presence of bacteria responsible for the infection can be readily detected in the milk.

Mastitis can be caused by a variety of factors, broadly categorized as infectious and non-infectious. Infectious agents, primarily bacteria like *Streptococcus agalactiae*, *Staphylococcus aureus*, and Mycoplasma spp., are the most common culprits. These bacteria can spread from

infected animals to healthy ones through close contact or shared milking equipment, leading to communicable mastitis. Alternatively, bacteria present in the environment can contaminate the udder and cause environmental mastitis. Non-infectious factors such as chemical irritants, physical trauma, or even stress can also trigger inflammation, albeit less frequently.

Early and accurate diagnosis is crucial for effectively managing mastitis. This often involves milk screening tests and veterinary examination. Treatment typically involves targeted antibiotics based on the identified bacteria. Penicillin G is often the first-line choice for susceptible strains, while broader-spectrum antibiotics are reserved for specific cases to minimize antibiotic resistance development. Additionally, immunomodulatory medications might be used in conjunction with antibiotics to support the immune system's response.

Beyond treatment, several control strategies are crucial to prevent and mitigate mastitis outbreaks. Maintaining proper hygiene during milking, ensuring udder health, and providing a clean and comfortable environment for animals are essential preventative measures. Early detection and prompt treatment of infected animals further help control the spread of pathogens. In some cases, culling animals with persistent infections might be necessary to break the transmission cycle.

Etiology and pathogenesis

Bovine mastitis is a complex disease with multiple contributing factors. The primary cause is infection by bacteria, although other factors such as physical trauma, chemical irritants, and allergic reactions can also play a role. The most common bacterial pathogens include:

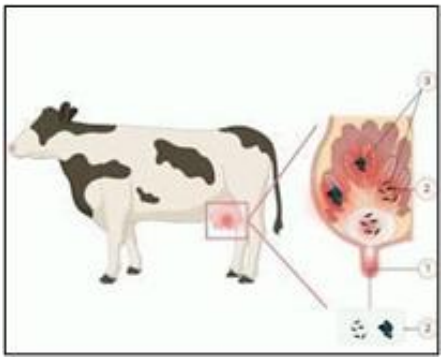
- Contagious pathogens: These bacteria are transmitted from cow to cow, typically during milking. They can persist in the udder even after an infection has been cleared. Examples include *Staphylococcus aureus*, *Streptococcus agalactiae*, and Mycoplasma bovis.
- *Streptococcus agalactiae* bacteria
- Environmental pathogens: These bacteria are found in the cow's environment, such as bedding, manure, and soil. They can enter the udder through the teat canal, especially during milking or when the cow is lying down in contaminated areas. Examples include *Escherichia coli*, Streptococcus uberis, and Klebsiella pneumoniae.

Pathogenesis

The pathogenesis of bovine mastitis involves a complex interplay between the invading pathogen, the cow's immune system, and the mammary gland environment. The following steps are typically involved:

1. Bacterial invasion: The bacteria gain entry into the udder through the teat canal. This can occur during milking, when the teat sphincter is relaxed, or through breaks in the skin of the teat.
2. Bacterial multiplication: Once inside the udder, the bacteria begin to multiply. The rate of multiplication depends on the virulence of the bacteria and the cow's immune status.
3. Immune response: The cow's immune system recognizes the bacteria as foreign and mounts an inflammatory response. This response includes the recruitment of white blood cells to the udder, the production of antibodies, and the release of inflammatory mediators.
4. Tissue damage: The inflammatory response can damage the mammary gland tissue, leading to swelling, redness, and pain. This damage can also interfere with milk production.
5. Clinical signs: If the infection is severe enough, the cow may develop clinical signs of mastitis, such as fever, decreased milk production, and visible abnormalities in the milk (e.g., flakes, blood).

Types of mastitis



- Clinical mastitis: This type presents with visible signs of udder inflammation, such as redness, swelling, heat, pain, and abnormal milk (flakes, blood).
- Subclinical mastitis: This type lacks visible signs but is detectable through milk analysis, showing increased somatic cell count (SCC) indicating inflammation.

Cause of Infection:

- Contagious mastitis: Caused by bacteria transmitted between cows, primarily during milking. Common contagious pathogens include *Staphylococcus aureus*, *Streptococcus agalactiae*, and Mycoplasma bovis.
- Environmental mastitis: Caused by bacteria from the cow's environment, like bedding, manure, or soil, entering the udder through the teat canal. Common environmental pathogens include *Escherichia coli*, Streptococcus uberis, and Klebsiella pneumoniae.

Course of Infection:

- Acute mastitis: Sudden onset of severe clinical signs, often with systemic illness like fever and anorexia.
- Subacute mastitis: Milder and less persistent clinical signs compared to acute mastitis.
- Chronic mastitis: Long-term, recurring infection with mild or no clinical signs, often caused by environmental pathogens.

Additional Types:

- Summer mastitis: Primarily affects heifers or non-lactating cows during hot, humid weather, caused by environmental pathogens.
- Gangrenous mastitis: Rare but severe, causing rapid tissue death and gangrene in the udder, often due to Clostridium species.

Clinical presentation and diagnosis

Clinical mastitis:

Udder:

Redness: The udder appears inflamed and redder than usual.

- Reddened udder in cow with mastitis
- Swelling: The udder becomes swollen and firm, often noticeably larger than usual.
- Swollen udder in cow with mastitis
- Heat: The affected udder feels warm to the touch, indicating inflammation.
- Pain: The cow may show discomfort or resist milking due to udder pain.

Milk:

- Abnormalities: Milk may appear abnormal, with flakes, clots, blood, or pus present.
- Milk with flakes from cow with mastitis
- Watery consistency: Milk may be watery and thin, lacking its usual creamy texture.
- Decreased milk production: Milk yield may be reduced due to udder inflammation.

Cow:

- Fever: The cow may have an elevated body temperature, indicating systemic inflammation.
- Lethargy: The cow may appear less active and sluggish due to discomfort or illness.
- Loss of appetite: The cow may lose interest in food due to pain or illness.
- Reluctance to be milked: The cow may resist milking due to udder pain or discomfort.

Subclinical mastitis:

- No visible udder or milk abnormalities.
- Increased Somatic Cell Count (SCC) in milk: Detected through routine milk analysis, indicating inflammation even without visible signs.
- Additional Symptoms:
- Sunken eyes: May indicate dehydration due to reduced fluid intake or increased fluid loss.
- Diarrhea: Can be a sign of systemic infection or discomfort.
- Reduced mobility: The cow may be less willing to move due to udder pain or discomfort.

Diagnosis:

Visual inspection of bovine mastitis:

Visual inspection is an important first step in diagnosing bovine mastitis, even though it alone cannot confirm the presence or type of infection. Here's what you should look for when examining your cows:

Udder:

- Redness: Look for any areas of redness or inflammation on the udder, especially around the teats or individual quarters. This can be a sign of infection or irritation.
- Swelling: Pay attention to any swelling or asymmetry in the udder. One quarter may appear larger or more swollen than the others, indicating potential mastitis in that specific area.
- Heat: Feel the udder surface for any areas that feel warm or hot to the touch. This can also indicate inflammation and potential infection.
- Skin lesions: Check for any wounds, cuts, scrapes, or other skin lesions on the udder. These can be entry points for bacteria and contribute to mastitis development.
- Test abnormalities: Observe the teats for any abnormalities like cracks, scabs, or discharge. These can indicate teat injuries or infections, potentially leading to mastitis.

Milk:

- Discoloration: Normal cow's milk is typically white or slightly yellowish. Look for any changes in color, such as pink, yellow, greenish, or bloody milk, which can indicate the presence of blood, pus, or other abnormal substances.
- Flakes or clots: Observe the milk for the presence of flakes, clots, or stringy formations. These can be signs of inflammation or infection within the udder.
- Watery consistency: Healthy milk has a certain viscosity. If the milk appears watery or thin, it could be a sign of mastitis affecting milk production and composition.
- Cow's behavior:
- Reduced milk production: Pay attention to any changes in milk yield from individual cows or the entire herd. A sudden drop in milk production can be a sign of mastitis or other health issues.
- Lethargy: Observe the cow's overall demeanor. If she appears lethargic, disinterested in eating, or shows signs of weakness, it could be related to mastitis or other underlying conditions.
- Loss of appetite: A healthy cow will have a good appetite. Reduced appetite or refusal to eat can be a sign of discomfort or illness, potentially indicating mastitis.
- Milking behavior: During milking, observe the cow for any signs of discomfort or kicking resistance. This could indicate pain or inflammation in the udder, potentially due to mastitis.

Somatic cell count

Detection of subclinical mastitis is best done by testing milk for somatic cell counts (SCCs) (predominantly leukocytes) using either the California Mastitis Test or automated methods provided by dairy herd improvement organizations. SCCs are positively correlated with the presence of infection. Inflammatory changes and decreases in milk quality may start with SCCs as low as 100,000 cells/mL. Although variable (especially if determined on a single analysis), an SCC of ≥200,000 cells/mL in a cow indicates a high likelihood of infection. Likewise, the higher the SCC in a herd bulk tank, the higher the prevalence of infection in the herd. Herd SCCs < 200,000 cells/mL are considered desirable, and lower counts can be attained.

Cow behavior

Sickness in animals cause changes in their behavioural motivation and leads to decreased activity in exploration, body care and sexual behaviour as well as poor appetite, a well-described behavioural pattern called sickness behaviour. The sickness behaviour is a well-organised

adaptive response by the animal to enhance disease resistance and facilitate recovery from disease (Johnson, 2002). However, several factors have been found to override sickness motivated behaviours, including fear (Aubert, 1999), maternal behaviour (Aubert *et al.,* 1997) and pain (Bolles and Fanselow, 1980). Also species, affected organ, physiological state, individual pain threshold, few to mention, may have an effect on the behavioural response to sickness. Animals' pain threshold and physiological and behavioural responses to different diseases and pain can vary depending on how severely it distorts animals' physiological and behavioural functioning (Kemp *et al.,* 2008).

Overall cows spent less time lying on the induction day than on the day before, and less on the side of the inflamed udder quarter. Cows also spent longer time overall for eating silage during the induction day, and they also stepped more than during the previous day. Cows spent less time lying and ruminated and drank less when the udder was severely swollen and when they had high fever. We concluded that unlike in typical sickness behaviour, cows did not increase their time spent lying, but instead stood more, and avoided lying on the side of the inflamed udder quarter. We suggest that pain experienced in the udder overrides the motivational the state of the cows' sickness behaviour.

Palpation

Palpation plays a crucial role in diagnosing bovine mastitis, alongside visual inspection and laboratory tests. It allows you to assess the udder's physical characteristics and potentially identify abnormalities indicating inflammation or infection. However, it's essential to remember that palpation alone cannot definitively diagnose mastitis and should be combined with other approaches.

Here's what to consider when palpating the udder for mastitis diagnosis:

Technique:

- Cleanliness: Wash and sanitize your hands thoroughly before starting the examination.
- Systematic approach: Palpate each udder quarter individually, starting from the base and working towards the teats.
- Gentle pressure: Apply gentle but firm pressure, avoiding causing discomfort to the cow.
- Comparison: Compare the feel of each quarter to ensure consistency in size, firmness, and temperature.

Abnormalities to look for:

- Lumps or hardness: Feel for any lumps, bumps, or hardened areas within the udder tissue. These can indicate inflammation, abscesses, or scar tissue from previous infections.

- Pain: Observe if the cow shows any signs of pain or discomfort during palpation, particularly in specific quarters. This could suggest inflammation or infection.
- Temperature: Assess the temperature of each quarter. Warmer than usual areas may indicate inflammation or increased blood flow due to infection.
- Asymmetry: Compare the size and shape of each quarter. One quarter being significantly larger or more swollen than others can be a sign of mastitis.
- Fluid accumulation: Check for any abnormal presence of fluid within the udder tissue, indicating edema or inflammation.

Calfornia Mastitis Test (CMT)

The California Mastitis Test (CMT) is a diagnostic tool to aid in the quick diagnosis of mastitis in dairy cows, and for an udder health management program. . The CMT is performed to; Detect the presence of subclinical infections at the beginning of or during

lactation as part of an udder health management program. Additional diagnostics for cows with clinical signs of Mastitis.

Risk factors

Several factors intertwined with the cow itself can raise its susceptibility to mastitis. Genetics and breed play a significant role, with high-yielding breeds like Holstein-Friesian being more vulnerable compared to lower-yielding ones like Jerseys or Rendena cattle. This difference arises from inherent genetic predispositions. Additionally, multiparous cows face increased risk due to weakened immunity associated with multiple births.

Udder conformation directly impacts susceptibility. Features like large, funnel-shaped teats, pendulous udders, and blind quarters create entry points for bacteria, increasing the risk of subclinical mastitis. Interestingly, even teat size and distance from the floor influence the effectiveness of immune cells in milk, impacting mastitis occurrence.

Finally, age is a crucial factor. As cows age, their teat canals widen, potentially staying partially open from frequent milking, making them more prone to infections. Furthermore, the mammary epithelium in older cows becomes more permeable due to past inflammations, further weakening their defenses.

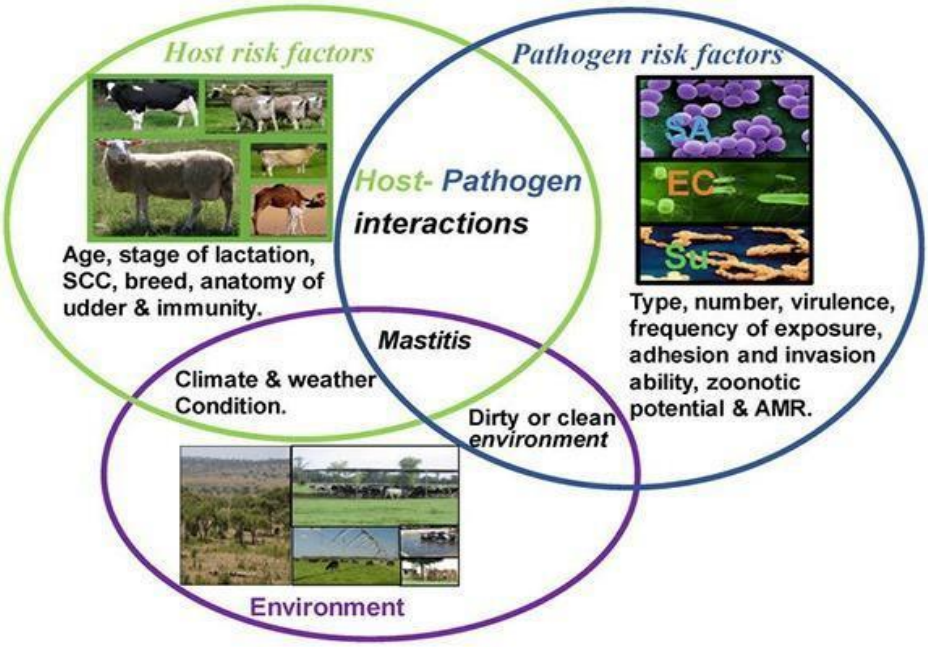
By understanding these inherent factors, dairy farmers can make informed decisions about breed selection, udder conformation evaluation, and age-specific management practices, ultimately contributing to healthier herds and reduced mastitis prevalence.

Moving beyond genetics, management practices emerged as key players. Poor udder hygiene and medium milk yields correlated with increased mastitis risk, emphasizing the

importance of cleanliness and optimal milking routines. Notably, the sole reliance on washing for udder hygiene presented a slightly higher risk compared to more comprehensive methods. Additionally, farm hygiene itself played a role, with smaller farms (10-42 herds) showing a trend towards higher prevalence.

Dairy cow research pinpoints several culprits behind mastitis, an udder infection impacting milk production. Herds with 10-42 cows saw higher risk, while milking infected cows last offered relief. Poor udder hygiene and medium milk yield were red flags, with washing-only practices further increasing risk. Interestingly, farm hygiene had less impact than individual cow care. Age played a role, with 6-9 year olds most susceptible. Breed mattered too, with Jerseys topping the risk list, followed by Holstein Friesian crosses. Indigenous Zebu breeds fared best. Cows birthing 1-3 calves and those with poor body condition or past infections were also more vulnerable. The good news? Meticulous hygiene, strategic milking order, and focused cow health management can significantly lower mastitis risk. Even breed selection and age awareness can make a difference.

Environmental conditions and management practices of the herds have decisive effects on animal health and welfare. Keeping the herd clean and comfortable can reduce the incidence and severity of mastitis. High stocking density, contaminated floor, wet bedding, poor ventilation, and hot and humid climate can promote growth of mastitis pathogens and increased exposure of cows, resulting in higher occurrence of mastitis



Streptococcus agalactiae, a sneaky gram-positive pathogen, poses a unique threat to dairy herds by causing contagious mastitis. Unlike other culprits, it lurks not only in the environment

but also within cows' digestive systems, allowing it to spread through milking equipment and even contaminated drinking water. This highlights the critical need to expand mastitis prevention beyond just udder and milking hygiene. A recent study emphasizes the importance of incorporating fecal and environmental management practices to truly control Strep. agalactiae infections.

Moreover, this pathogen is particularly cunning, causing subclinical mastitis. While milk appears normal, it harbors a high Somatic Cell Count (SCC) and suffers from reduced production. To make matters worse, Strep. agalactiae can indefinitely reside within the mammary glands, forming protective biofilms that shield it from the immune system and harsh conditions. This persistence makes treatment and eradication a significant challenge.

Mycoplasma spp. Contagious mastitis caused by Mycoplasma spp. is less common than Staph. aureus and Strep. agalactiae infection. However, it is highly severe and damages secretory tissues, and induces gland and lymphatic nodule fibrosis and abscesses. Outbreak of Mycoplasmal mastitis is sporadic without any deliberate intervention. Although it is self-limiting, it produces biofilm and invades host cells, and does not respond to antibiotic treatment . The only control is by regular monitoring and rapid segregation or culling of infected cows.

Impact on milk quality and production

This research delves into the impact of mastitis on milk composition, revealing interesting insights. In terms of fat content, a statistically significant difference was observed amongst different mastitic milk samples, aligning with previous findings that reported decreased fat due to mastitis. However, the study acknowledges that individual cow variations can also affect fat content, highlighting the need for further investigation. Breed wasn't identified as a contributing factor in this study, although other research suggests its potential influence.

Moving beyond fat, the study confirms alterations in protein composition during mastitis. An increase in milk proteins was observed, attributed to an influx of blood-borne proteins coupled with a decrease in caseins. This aligns with past research on mastitis-induced protein changes.

Interestingly, the findings on overall fat content differ from some previous studies. While some reported similar decreases, others noted an increase. This underscores the complexity of mastitis' effects and the potential role of specific mastitis types or other factors.

Finally, a decrease in lactose concentration and changes in ionic balance were observed, echoing common findings that associate mastitis with reduced lactose and altered ion concentrations in milk.

Overall, this research contributes to our understanding of how mastitis influences milk composition. However, it also highlights the multifaceted nature of these changes and the need for further exploration to fully understand the interplay between mastitis, breed, individual cow variations, and specific mastitis types in shaping milk composition.

(Courtesy of Ronald Erskine)

Treatment and management

Antibiotic therapy

The main strategy to treat mastitis is by the use of antibiotics, such as penicillin, ampicillin, tetracycline, gentamicin, etc., which can be given by intra-mammary infusion, intramuscular or intravenous injections. The DCT is one of the best choices to control and inhibit progression of mastitis. Dry period is an important stage in the lactation cycle; any infection during the dry period will affect the next lactation, and therefore, it is very important to take care of the cow's health before the next milking cycle. Before drying off the cows, they were checked for any sign of mastitis; chronic mastitis cases, which are hard to detect by naked eyes, were checked via the California mastitis test (CMT). Then, right after the last milking, intramammary injection of antibiotic was applied to cow udder through canal teat, followed by application of teat sealant, which simulates the keratin plug, providing a physical barrier to bacterial invasion and preventing milk leakage.

In some severe cases, where the inflammation is serious and the milk cannot be milked out completely, milk ducts will be blocked by milk debris, which will block the spreading of antibiotics throughout the udder. In that case, parenteral administration is advisable together with intra-mammary infusion on the advice of a veterinarian. Long acting antibiotics are not suitable for mastitis detected during lactation, as getting the cow back to milking is the primary concern; therefore, it is important to gain knowledge about pathogens present in order to select appropriate cures for infected cows.

Vaccination

Vaccinating cows can be deemed as a preventive mastitis treatment in herds. Most vaccines are designed to target Staph. aureus, Strep. agalactiae, and E. coli. Vaccines targeting Staph. aureus and Strep. agalactiae are made up of either the whole organism (inactivated, high encapsulated or unencapsulated cells, and attenuated vaccines) or subunits (toxins, bacterial surface extract, and crude extract of polysaccharides).

Table 1: Information regarding drugs used against specific infecting species

Micro-organism	Species	Drug of Choice	Alternative	Comments
Streptococci	*Streptococcus agalactiae* Streptococcus dysgalactiae *Streptococcus uberis*	Penicillin G		IMM treatment preferable.
	Enterococci	According to susceptibility testing		Prognosis for bacteriological cure is poor
Staphylococci	*Staphylococcus aureus* Coagulase negative staphylococci β-lactamase -ve	Penicillin G		Combination treatment in S. aureus mastitis
	Staphylococcus aureus Coagulase negative staphylococci β-lactamase +ve	No antimicrobials	Cloxacillin Macrolides Lincosamides	IMM and/or systemic treatment depending on the drug used. Prognosis for S. aureus mastitis is poor. Cloxacillin may select for methicillin-resistant
Coliforms	*Escherichia coli* Klebsiella spp.	No antimicrobials	Fluoroquinolones Cephalosporins	Antimicrobials necessary in serious cases and during puerperal period

while for E. coli, the mutant core antigen J5 was used widely. However, vaccines are yet to provide reliable protection. For example, a widely available commercial vaccine named Startvac (Hipra SA., Girona, Spain) targeting Staph. aureus was studied in few reports. demonstrated that Starvac can only moderately reduce new infection and duration of mastitis; whereas Bradley et al reported that there was a significant reduction in severity of disease but increased milk production in Starvac-vaccinated cow when compared with non-vaccinated cow. Soon after that, Starvac was reported to be ineffective in improving udder health, milk production, or survival. These varying degrees of vaccine efficacy might be associated with varying management practices of different herds.

Hence, regardless of the type of vaccine, vaccination alone is not effective in preventing mastitis, especially in dairy herds that have high mastitis rates. Vaccination has to be coupled with other control procedures, such as hygienic milking, antibiotic treatment, infected cow culling, and so on, to reduce the incidence and duration of mastitis cases.

Future directions and research

Nutraceuticals

Herbal therapy shows potential in treating bovine mastitis due to its lack of adverse effects and various benefits. It can act as an alternative, adjunctive, or replacement therapy to antibiotics.

Key advantages:

- Anti-bacterial, anti-inflammatory, and immunomodulatory properties: Herbs can fight bacterial infections, reduce inflammation, and boost the immune system, aiding in mastitis recovery.
- Pain relief: Certain herbal extracts show analgesic effects comparable to pain medication.
- Cost-effectiveness: Compared to antibiotics, herbal treatments can be significantly cheaper, making them accessible to wider populations.
- Antioxidant protection: Some herbs can minimize oxidative stress and inflammation in the udder tissue.
- However, important points to consider:
- Efficacy: While promising, some research suggests antibiotics may be more effective in certain cases.
- Route of administration: Different formulations require specific administration methods like topical application, oral intake, or direct udder injections.

Further research needed: More studies are needed to fully understand the long-term effects, potential interactions, and optimal dosages of herbal treatments for mastitis.

Curcumin, the major compound of turmeric, was claimed to be one of the best potential therapeutic agents against bovine mastitis treatment. Fu et al injected curcumin 1 h before and 12 h after LPS treatment to mammary gland duct of mouse. They found out that it could attenuate the activity of myeloperoxidase, which was reflected by neutrophil accumulation in the mammary gland. The LPS-induced TNF-α, IL-6, and IL-1β were inhibited by curcumin through decreased expression of TLR4, and phosphorylation of IκBα and NF-κB p65. In addition, nanoformulation of curcumin showed even better effect in attenuating inflammatory responses induced by Staph. aureus in a mouse model when compared with normal curcumin. In another study, the effect of turmeric on udder health of dairy cows was evaluated with a phytobiotics-rich herbal mixture (PRHM), which was made up of 18% turmeric roots, 18% cinnamon barks, 60% rosemary leaves, and 4% clove buds. Results showed that supplementation of PRHM were able to lower the SCC, especially in high SCC cows, demonstrating that PRHM could improve cow's udder health. In addition, cows supplemented with PRHM also consumed more feed dry matter, which can improve feed utilization efficiency and produce a greater amount of milk, proving to be an effective strategy to enhance performance in cows afflicted with mastitis.

Conclusion:

Bovine mastitis, an inflammatory response in the mammary gland, poses a significant economic and welfare burden on the dairy industry. Understanding its diverse causes, from infectious agents to environmental factors, is crucial for effective management. Early and accurate diagnosis through visual inspection, milk analysis, and palpation is key, alongside employing a multi-pronged approach to combat the issue.

Treatment relies heavily on targeted antibiotics based on identified bacteria, with penicillin G often the first-line choice. However, concerns regarding antibiotic resistance necessitate exploring alternative solutions like immunomodulatory medications and nutraceuticals. Vaccination shows promise but requires further research and integration with other preventative measures like hygiene practices and culling infected animals.

Future directions lie in exploring the potential of nutraceuticals like curcumin, harnessing their anti-inflammatory and immunomodulatory properties. Continuous research into novel treatment options, combined with robust preventative strategies, holds the key to mitigating the impact of mastitis and ensuring the well-being of dairy cows and the sustainability of the industry.

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REVIEWING THE GROWTH OF ACOUSTIC NEUROMAS: A COMPREHENSIVE ASSESSMENT & CARE APPROACH

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Abstract:

Atypical Schwann cell growth leads to acoustic neuromas. These tumours begin in the area of Scarpa's ganglion, which is situated in the internal capsule and is where the vestibular nerve's peripheral and central myelin meet. IAC (auditory canal) [1]. Cranial nerves VII and VIII are located within the bony limit of the IAC. These structures are compressed when there is a tumour mass present. There is also a chance that the expanding tumour mass will prolapse into the cerebellopontine angle (CPA). The tumour eventually presses against the cerebellum and brainstem as it grows larger. The disease's clinical history may be complicated even though these tumours are benign.

Keywords: Acoustic neuromas, Cerebellopontine angle, Internal auditory canal, Neurofibromatosis

Introduction:

Vestibular schwannomas, commonly referred to as acoustic neuromas, account for around 85% of tumours in the area and about 6% of all cerebral tumours. the angle of the cerebellopontine. Atypical Schwann cell growth leads to acoustic neuromas. These tumours begin in the area of Scarpa's ganglion, which is situated in the internal capsule and is where the vestibular nerve's peripheral and central myelin meet. IAC (auditory canal). [1] Cranial nerves VII and VIII are located within the bony limit of the IAC. These structures are compressed when there is a tumour mass present. There is also a chance that the expanding tumour mass will prolapse into the cerebellopontine angle (CPA). The tumour eventually presses against the

cerebellum and brainstem as it grows larger. The disease's clinical history may be complicated even though these tumours are benign. [2]

The most frequent cerebellopontine angle (CPA) tumour typically originates in the internal auditory canal (ICA) and is known as an acoustic neuroma. However, despite the VIIth and VIIIth cranial nerves originate in the vestibular division of the VIIIth nerve, not the acoustic division, and run in the IAC. The inferior and superior vestibular nerves are the two divisions of the vestibular nerve found in the IAC. The SVN is in charge of the calorie response and innervates the lateral semi-circular canal. This tumour has been assumed to originate from the SVN due to the high frequency of impaired caloric response observed in patients with acoustic neuromas. [3,4]

As a result of advancements in diagnostic modalities like MRI, a growing number of tiny neuromas are being identified recently, and individuals with normal. In the otolaryngological clinic, calorie reactions are frequently observed. Thus, the question of whether the majority of acoustic neuromas originate from the SVN has been called into question. We describe in this text the nerve origin of auditory neuromas based on our personal surgical expertise. [5]

Previously believed to be primarily a condition affecting the superior vestibular nerve, acoustic neuromas now occur on both the inferior and superior vestibular nerves with roughly similar frequency. [2] Two classifications apply to acoustic neuromas. Neurofibromatosis type 2 (NF-2) is linked to one kind. Bilateral auditory neuromas are seen in this uncommon autosomal dominant disease. NF-2 is linked to meningiomas, juvenile cataracts, and other cranial nerve neuromas in addition to the bilateral acoustic neuromas. [3] These patients typically appear in their early twenties or early adult years.

There are occasional cases of the more prevalent kind of acoustic neuroma [4]. This kind is always exclusive. In contrast to NF-2, these patients typically manifest later in life and do not have any other comorbidities.

There is no recognised aetiology for hearing loss linked to acoustic neuromas. Because of its location in the cerebellopontine ganglia close to the auditory nerve. It seems sense that the primary cause of the auditory nerve's malfunction would be the angle or internal auditory canal. Indeed, a noteworthy histopathologic finding in cases with auditory neuromas is the apparent degeneration of spiral ganglion cells, as demonstrated by histopathology of the human temporal bone’s” But an absence of connectivity the absence of a relationship between the quantity of nerve fibres that remain in the internal auditory canal and auditory threshold or speech discrimination, and the size or volume of an acoustic neuroma and hearing levels, implies that while neuronal degeneration is widespread, hearing loss is not always sufficiently explained by it on its own neural tumour of hearing. [6,7]

Congenital malformation of the inner ear canal

The development of the internal auditory canal (IAC) quality is influenced by the growth of the vestibulocochlear nerve. This parallels findings from the examination of other foramina in the skull base, which tend to enlarge in response to the nearby presence of regional arteries or nerves. Consequently, a hypoplastic internal auditory canal (IAC) containing only the facial nerve is often associated with congenital deficits in the vestibulocochlear nerve. The IAC is regarded as hypoplastic when its diameter is less than 2 mm, despite the fact that measurements are sometimes arbitrary. Examining the axial and coronal planes normally yields the finest appreciation of this; nevertheless, high-resolution thin-section oblique sagittal T2W MR imaging not only shows this little canal but also, and to the best of its ability, shows vestibulocochlear nerve hypoplasia or absence. [8,9]

When compared to any of the vestibular nerves, the cochlear nerve is considered hypoplastic if its size is comparable or smaller. If the internal auditory canal (IAC) is normal in size, then cochlear nerve insufficiency suggests that the cochlear nerve was acquired after the IAC formed. Patients with labyrinthitis ossificans have been the most frequently observed to exhibit this. Patients in need of cochlear implantation must consider the critical consequences of abnormal vestibulocochlear nerve calibre. Lack of a cochlear. The sole total contraindication to this surgery is nerve. The imaging specialist has to assess not only the IAC calibre but also the condition of the cochlear nerve aperture at the fundus of the IAC. A significant correlation exists between cochlear nerve insufficiency and this aperture's stenosis. [10,11]

Osteomas and exostoses can cause the IAC to narrow. Despite their rarity, these bone lesions have the potential to simulate vestibular compressive vestibulocochlear nerve schwannomas. Following surgical excision of the bony lesion, vestibular symptoms such as vertigo and hearing loss may improve. As a consequence of other otodystrophies, such as fibrous dysplasia and Paget's disease, compromise of the IAC can also have happened. A significant IAC (more than 9 mm) could be accidental. Neurofibromatosis (NF)-2, which results from bilateral acoustic tumours, is associated with bilateral IAC enlargement. Due to dural ectasia in the absence of a tumour, NF can also produce an increase in the IAC. [12,13]

Tumor of the eighth cranial nerve (Acoustic Neuroma or Schwannoma)

Among CPA neoplasms, auditory neuroma, or Schwannoma of the eighth cranial nerve, occurs most frequently.7-9 These are midlife lesions that are slow-growing, noncalcifying, and well-encapsulated. 6% to 10% of all intracranial tumours and 60% to 90% of CPA tumours. They are more prevalent in certain cases and typically larger in females. Pregnancy may speed up this tumor's growth, based on compelling evidence. Even though they might be fully intracanalicular in origin, Schwannomas most frequently manifest as a mixed IAC/CPA lesion.

Remarkably, men tend to have more of these lesions in the latter category. Only the CPA cistern may be affected by schwannomas originating from the extracanalicular section of the nerve, sparing the IAC and seeming to be meningiomas. either an exophytic brainstem tumour or metastases. [14,15]

Clinical issues

Typically, eighth nerve schwannomas manifest as increasing unilateral high-frequency retrocochlear sensorineural hearing loss, most likely due to auditory nerve compression or infiltration. nerve fibres in the cochlea. When compared to pure tone loss, this hearing loss typically manifests clinically as disproportionately poor speech discrimination, as determined by brainstem electric response audiometry. It is frequent (26%) for hearing deficits to worsen suddenly, and this is most likely due to blockage of the anterior inferior cerebellar artery's (AICA) internal auditory branch. A tiny percentage of people have symmetric loss or intact hearing. [16]

If the patient is mostly experiencing non-auditory symptoms like vertigo or tinnitus, the clinician needs to remain suspicious. Noise in the ear is often unilateral (from the tumour side) and high-pitched in this situation. Peripheral vestibular dysfunctions, which may be caused by disruption of vascular supply, are known to produce vertigo, an episodic illusion of motion, and horizontal nystagmus. These symptoms usually appear early in tumour growth. bigger lesions may result in deafferentation, which is the impairment of sensory nerve impulses due to damage to sensory nerve fibres, which causes disequilibrium, a persistent feeling of instability. [17]

A big tumour with brainstem compression is frequently indicated by the presence of vertical nystagmus. It is uncommon for concomitant facial palsy to occur since the facial nerve can sustain significant twisting without losing its functional integrity. Recall that while the facial nerve is mostly motor, it also has a sensory component that supplies part of the pinna and external auditory canal. Hitselberger's sign is the term used to describe diminished sensation in this distribution. The fifth nerve symptoms (diminished corneal reflex, face numbness) are more likely to be caused by large lesions. It is rare but not unheard of for facial pain to be brought on by vascular impingement on the trigeminal root entrance zone. Cerebellar compression causes ataxia and intention tremor. Eighth nerve schwannomas originate from the vestibular, not the cochlear, part of the auditory nerve, despite the fact that the hearing impairment is progressive. about 85% of these patients had nerve damage. It is equally likely that the origin is in the superior or inferior vestibular nerves. [18]

Incidence and progression characteristics

Research investigating the natural progression of vestibular schwannomas is ongoing. Bakkouri et al. found that among 386 patients studied, 58% of the lesions grew by less than 1

mm per year, with a mean growth rate of 1.2 mm per year. Consequently, observation of 72 patients over an average follow-up period of 121 months revealed that 35% of the lesions progressed, indicating a median growth rate of 1 mm annually. Interestingly, in the same study, even among patients who did not exhibit tumor growth, there was evidence of hearing deterioration. [19]

Treatment overview

- Stereotactic Radiosurgery
- Fractionated Radiation Therapy
- Microsurgical Treatment
- Chemotherapy

Caye-Thomasen et al. conducted research to identify genes associated with vestibular schwannoma carcinogenesis by examining gene expression in the vestibular nerve, rather than focusing solely on human tumor tissue. Utilizing microarray technology, they identified specific transcripts with functional annotations related to carcinogenesis that were dysregulated in sporadic vestibular schwannomas. They plan to employ additional methods to evaluate genes involved in extracellular matrix function, cell adhesion, and protein binding. [20]

Treatment with bevacizumab, an anti-vascular endothelial growth factor (VEGF) monoclonal antibody, represents a promising advancement in managing developing acoustic neuromas in individuals with NF2. Immunohistochemistry examination of paraffin-embedded auditory neuroma specimens revealed expression of VEGF and the presence of VEGFR-2, a VEGF receptor subtype, in thirty-two percent of the cells. Furthermore, when treating a group of 10 NF2 patients, a 60% imaging response rate was observed, with most of the patients having previously undergone lesion treatment. Specifically, the best response to treatment showed a mean volumetric reduction of 26%. Following treatment, four patients experienced an objective hearing response. This could become the conventional treatment for NF2-associated auditory neuromas because the morbidity was negligible. [21,22]

In a cell culture study, Lee et al. investigated OSU-03012, a small molecule inhibitor derived from celecoxib, targeting phosphoinositide-dependent kinase-1. They noted increased inhibition of sporadic cell proliferation. OSU-03012 has demonstrated enhanced apoptosis in both malignant schwannoma cells and vestibular schwannoma cells, suggesting that it may have anticancer efficacy for malignant lesions and progressive vestibular schwannomas. [23,24]

Lapatinib is a small molecule receptor tyrosine kinase inhibitor, and in another in vitro investigation, vestibular schwannoma cultures were used to evaluate the preclinical efficacy of treatment, intermittent and vestibular symptoms linked to NF2 Merlin, a tumour suppressor, is lacking in schwannomas. Merlin appears to work with the activation of receptor tyrosine kinases,

which are involved in cell proliferation, as well as the activation of the epidermal growth factor receptor (EGFR), while the precise mode of action is uncertain. All samples of sporadic and NF2-related tissues showed activation of the EGFR family receptors, downregulation of survival, and an antiproliferative effect as a result, according to the investigators.

Conclusion:

The best course of action for treating acoustic neuromas at diagnosis, recurrence, or progression remains a challenge. Strong tumour control seems to be maintained by radiosurgical treatment for an ever-growing duration of additional monitoring years. Fractionated radiation therapy appears to provide the greatest functional outcomes for the hearing nerve, provided that the cochlear radiation dose is kept to a minimum. While microsurgical treatment may not yield equivalent outcomes for the facial and auditory nerves compared to radiosurgery, it remains the preferred cytoreductive therapy, especially for large lesions causing mass effect and obstructive hydrocephalus. Recent findings suggest that nearly complete or extensive subtotal resection (STR) of these lesions may lead to significantly better functional outcomes without substantially compromising tumor control rates.

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ASSESSMENT OF GROUNDWATER QUALITY IN DHOLPUR CITY (RAJASTHAN)

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Abstract:

This work is related to physical, chemical and biological behaviour as well as the contamination and the magnitude of ground water pollution by monitoring key water parameter such as NO_3^-, SO_4^{2-}, Cl^- and F^- etc. Hence, the sample collected from the area of Dholpur city have been analysed mainly for pH, Turbidity TDS, Conductivity ,DO and other key parameters. The experimental results have been summarized through tables and results so obtained have been compared with the average observation of BIS (Bureau of Indian Standard) presented in tables.

Keywords: Groundwater analysis, Dholpur, Rajsthan

Introduction:

Water is one of the most important components of the various segments of the environment, known as Hydrosphere. There are various sources of water but the purest form of water is rain water and most impure form of water exists in the various modes like sea water, Sewerage, Factory outlets etc. Total amount of water which is useful for the drinking purpose is very much less than the total water available in the universe (apprx.0.2%). The water bodies were to be the cheapest and convenient refuse disposal systems. This tendency has resulted in indiscriminate and excessive loading of waste matter into the aquatic systems, beyond their capacity of self purification. Normally over any short time interval in a water body not subject to human influence there is a balance, more or less between nutrient inflow and nutrient outflow. In recent times, mismanagement of surrounding areas of a water body has resulted into unprecedented nutrient enrichment of water bodies causing cultural eutrophication, which is manifested by raised tropic status, increased rate of sedimentation, loss of water storage capacity, lowered retention period and deteriorated water quality.

The physico-chemical characteristics of any aquatic ecosystem and the nature and distribution of its biota are directly related to and influenced by each other and controlled by a multiplicity of natural regulatory mechanisms. However, because of man's exploitation of the water resources, the normal dynamic balance in the aquatic ecosystem is continuously disturbed, and often results in each dramatic response as depletion of fauna and flora, fish kill, change in

physico-chemical character etc. Artificial changes which lead to such ecological responses are referred to as pollution and pollution stage may reach a stage when these valuable aquatic resources are no longer safe for human use.

Groundwater occupies a special place in the economy, primarily as the main fresh water resource, as well as for agricultural irrigation, and industrial utilization. Groundwater quality can be affected by hydrogeochemical process and anthropogenic impacts such as rapid urbanization, and industrial and agricultural development [1].

In many countries all over the world, groundwater has become an important part of the drinking water supply process for industrialized areas, for agriculture, and not least for household use [2,3]. Recently, the support of life on earth has been based on the supply of drinking water from groundwater aquifers. They are superior in quality and have a natural protection against microbial activities. Another quality of groundwater is that it can be found all over the globe [4]. Groundwater has recently served as the main source of water supply for the earth's populations; therefore, its quality is very important. Both anthropogenic and natural factors are the main sources of water contamination [5].

The loss of the integrity of groundwater occurs due to domestic, public, and industrial wastewater that seeps through various channels in the ground such as defective canals, absorbent boreholes, or even through the ground layer. Another cause is the infiltration of rainwater loaded with pollutants from the atmosphere or even from the soil, due to uninsulated open-air industrial landfills, such as: ash from thermal power plants, wood waste, chloro-sodic landfills, sugar factory sludge, household waste, or metallurgical slag. The suspended materials from vehicular traffic, tire wear, and oil and gas leaks from vehicles are deposited on pavements, and all this material is carried by rainwater and infiltrate the surface of permeable pavements and the other base layers, accumulating over time. Permeable pavement systems, unlike conventional pavement, can reduce the amount of pollutants transported by rainwater and therefore decrease the total quantity of pollutants delivered to the receiving water bodies [6].

Defective tanks containing various fluid substances, losses due to the transport of petroleum products or other fluids, and even loading and unloading stations are other causes of groundwater infestation with pollutants [2]. Some of the factors that destroy the quality of groundwater are soil characteristics, groundwater circulation through different types of rocks, topography, and saline water infusion in coastal areas; but human activities also have effects on groundwater [3]. Of major importance, due to the frequency of infestation by this process, is the spread of fertilizers and phytopharmaceuticals on the soil surface, which then, by means of atmospheric precipitation, infiltrate underground. Of all these aspects, prevention action is the only effective way to protect groundwater quality [2].

Groundwater pollution is a very common problem worldwide [7,8,9,10,11], as it poses a serious threat to both the environment and economic and social development. Groundwater resources are threatened globally due to population growth [12], rapid urbanization [13], and agricultural/industrial development [14]. Due to the industrializations, urbanization and agricultural activities and the population explosion most of sources of water either they are surface or ground water bodies are polluted or contaminated. Now day water require for domestic or industrial use is quite high but the supply of the required water is not sufficient for it. So in order to keep the quality of water at optimal level continuous periodical monitoring of water quality parameters is necessary so appropriate step may be taken for the water resources management practices. The studies of physico-chemical parameter of ground water of various regions have been carried by various researchers.

Brief review of the work already done

A lots of work have been done on the water by taking the different parameter and identified that the quality of ground and surface water is decrease day by day and various impurities are introduce depending on the region and the area. Specially in the river area like Yamuna, Ganga, Kaveri, Godawari, Koshi, Tapti, Saraswati, Chambal etc. and the different regions in by India. By considering the different physico-chemical parameters and properties of the water various researchers have contributed a lot like Patil studied the "physico-chemical parameter of the ground water near Tapti river at Bhusawal". .Jha have studied the different "physico-chemical parameter of ground water of Banmukhi town of Purnea" Dist.(Bihar),.Dhake and Phalakhave studied the "Seasonal variation the ground water quality at south zone of Bhusawal Taluka,Dist. Jalgaon "(Maharashtra), Chaudhary and Shrivastava have done the Correlation regression study on "Modeling of the industrial waste water quality parameter MIDC (Waluj), Aurangabad (MS) Gupta and G.R.Chaudhary have done the "correlation and regression study among the ground water quality parameter"Jalgaon (M.H.),M.K.Singh and P.STiwari have done the "Physico-chemical study of Chambal river water in Dholpur"(Rajasthan).Neera Srivastava, Meena Agrawal and Anupama Tyagi have done the "physico chemical study of water at Jaipur region"(Rajasthan), Gupta BK,Gupta RR "Physico-chemical and biological study of drinking water in Satna" Madhya Pradesh -- 485 001 (India). Shyamala, et al., "Physico-chemical analysis of borewell water sample of Telungupalayam area in Coimbatore Dist. (Tamilnadu),S.R.Patel and K.K.Desai "Study on some physico chemical and Microbialogical patable water in some rural areas of Surat Dist.(Gujrat**),** B.D. Tripathi, M. Sikandar, Suresh C. Shukla "Physico-chemical characterization of city sewage discharged into river Ganga at Varanasi"(UP),India.

Sonawane, Vilas. (2020) stated that the water is a vital resource for human survival. The availability of good quality water is an indispensable feature for prevents diseases and improving

quality of life. It is necessary to know details about different physical parameters like color, temperature, Total hardness, pH, sulphate, chloride, DO, BOD, COD, and alkalinity used to test water quality. This paper aims to analyze water quality using the Physicochemical parameters of water samples collected from the Vishnupuri dam in Nanded district, Maharashtra, India. [1] Bansal AK et. al. (2019) stated that the water is the basic unit of life and it is essential element for all living forms and the environment health. Water is the basic unit of life and it is essential element for all living forms and the environment health. Rivers are essential for all living organism on earth. [2] Shalini, Sharma PK, Naithani P et. al. (2018) stated that a study was conducted in Haridwar to evaluate the effect of industrial effluent on groundwater. A total number of seven water samples were considered, five samples were collected from State Industrial Development Corporation of Uttarakhand Limited (SIDCUL) and two ground water samples were collected from Salempur, a village situated nearby SIDCUL, Haridwar. Samples were analyzed for parameters such as pH, Total Dissolved Solids (TDS), Total Suspended Solids (TSS), Total Solids (TS), total hardness, electrical conductivity, salinity, Lead (Pb), Chromium (Cr), Arsenic (As), Iron (Fe), Aluminium (Al), Manganese (Mn) and Nickel (Ni). The results were compared with limits prescribed by Bureau of Indian Standards. It was observed that ground water near the industrial area has been polluted. It can be concluded from the study that waste water of industry is affecting the ground water quality and thus posing a major threat to health of the people living in Salempur. [3] Skinder BM et. al. (2013) stated that the Water quality assessment was carried out on the Tawa River for the period of January 2006 to May 2006. The study revealed that the river (stream) exhibit slight temporal and spatial variation in physico-chemical characters of water. [4] Bheshdadia, B.M. et. al. (2012), studied Physico-chemical analysis such as temperature, salinity, alkalinity, total hardness, phosphate, sulphate, nitrate, pH, electrical conductivity, T.D.S., turbidity, dissolved oxygen, fluoride, chloride of bore well water was carried out from twenty five sampling stations of morbid-malia territory during may-2010 (before monsoon) and Oct.- 2010 (after monsoon) in order to assess water quality. In the present study temp in may- 2010 ranged form 29.6°C to 32.6°C and Oct 2010 ranged from 29.1°C to 31.8°C. Dissolved oxygen ranged in both season out of range i.e. minimum tolerance range 4.0 ppm for drinking water. In this study pH in May-2010 ranged 7.10 to 8.90 and Oct 2010 ranged 7.62 to 9.02 i.e. some sampling stations shows pH higher than the prescribed range. Turbidity of all sampling stations have shown lower NTU values than the prescribed range. TDS also shows in some sampling stations higher than prescribed limit. Phosphate in May2010 ranged from 13-41 mg/l .and in Oct. 2010, 10-39 mg/l. this is higher than the prescribed value. Total hardness in May-2010 ranged 110 to 960 ppm and in Oct 2010, 85 to 920 ppm i.e. higher in some sampling stations than tolerance limit. Chloride also in this study is higher than the prescribed limit of chloride. The study has shown that the essential elements in water like TDS,

salinity, phosphate, nitrate, pH, total hardness, chloride are higher than tolerance range. Therefore bore well water in this territory is not suitable for drinking purpose. [5] Boral, S.B. et. al. (2012), The study of Physico-chemical analysis of ground water for. In drinking from selected sample points around the Banmeru science college, Lonar Buldhana district of Maharashtra the present study, the ground water samples were collected from selected sampling stations around the late Ku. Durga K. Banmeru science college, Lonar dist. Buldhana and analyzed for its various analytical parameters related to quality of drinking water prescribed by WHO, ICMR, ISI etc. In this study Mg, dissolved oxygen, chloride, nitrate, phosphate, copper, iron was analyzed. [6] From the results selected points are of poor quality and they require higher degree of treatment before consumption and hence some following treatment methods are suggested in this study: ➢ An adequate filter system before the use which will remove suspended solids and colloidal particles. ➢ Proper aeration by keeping the water in atmosphere and addition of KMnO4 after pumping the water from bore well. ➢ Addition of coagulant like alum to water. ➢ Hot soda-lime solution should be used for the precipitation of metallic salts. Kalra,N. *et al.* (2012), Physico -chemical analysis of ground water taken from five blocks (Udwantnagar, Tarari , Charpokhar, Piro, Sahar)of southern Bojpur (Bihar). The study area comprises of Bhojpur district of Bihar State. Bhojpur is one of the thirty eighty district of Bihar state and their administrative head quaeters are located in ara town. It is a part of Patna division. Bhojpur district (plate 1) falls within 250 00 ” to 250 30” N and 840 15” to 840 45”E, the area is bounded by river son in the east, Darmawati -Gangi rivers in east and river Ganga in the North. Its area spread over a total geographical .area of 3395 sq/km. The district has three subdivisions of Arasadar, Jagdishpur and Piro. The block of the district include Arasadar, Udwantnagar, Jagdishpur, Koliwan, Sahar, Barhara, Sandesh, shahpur, Charpokhari, Piro,Tarari, Bihia,Agiawon and Garhami. In the present research PhysicoChemical analysis was carried out for the five blocks of Southern Bhojpur. In the Physicochemical analysis, various quality parameters are measured including pH, turbidity, electrical conductivity, total dissolved solids, total hardness, content of calcium, magnesium, chloride, sulphate, Iron, DO, COD, BOD, total alkalinity and Nitrate concentration present in ground water, Also all the parameters were compared with ICMR standards of water quality. Also, in the present research paper classification of water samples of five blocks was investigated on the basis of TDS and TH.

Khan, R.M. *et al.* (2012), physico chemical analysis of Triveni lake water of Amravati district in (M.S) India. In the present investigation involves the analysis of water quality in relation to physico-chemical parameters, Triveni lake of Amravati district of Maharashtra was selected for physico-chemical analysis of water. The lake is source of drinking and irrigation water for 15 villages under the canal irrigation. Now a days lake water was polluted due to

domestic waste and agricultural discharge. physico-chemical parameters of Triveni lake water were studied and analyzed for the period of one year i.e December 2010 to Nov.2011.In order to understand the water quality of Triveni lake various physico-chemical parameters such as water temperature, air temp. pH, humidity conductivity total hardness $CaCO_3$, Ca++ , Mg++ were studied. The result revealed there was significant seasonal variation in some physico-chemical parameters and most of the parameters were in normal range and indicate better quality of lake water, It has been found that the water is best for drinking purposes in winter and summer seasons. [8] Khound *et al.* (2012), Physico-chemical studies on surface water quality in the Jia Bharali river basin, North Brahmaputra plain, India. The Jia Bharali river catchment area is bounded by longitudes 92000'-93025' E and latitudes 26039' - 280 00' N. The Jia Bharali, one of the major tributaries of the river Brahmaputra, flows down from the lower Himalayas in Arunachal Pradesh in the north eastern India and runs through the middle of Sonitpur district of Assam. This study presents a comprehensive assessment of surface water quality of the area based on analysied of six data sets representing 35 points sources and three consecutive years (2008-2010). The physico-chemical parameters show variable spatial and temporal relationship. The major ion contents show the trend Ca>Na>Mg> K while anion composition follows the trend HCO3>Cl>SO4>>PO4>NO^3 in both the wet and the dry season. with respect to the physico-chemical parameters the surface water sources of the Jia- Bharali catchment and adjoining area are found to be suitable for domestic, agricultural and Industrial use. spatio - temporal variability of the physico - chemical parameters from this study may be used as future baseline data to monitor and manage any changes with changing land use. [9]

Water sampling

Municipal water samples were collected from Site I, II, III in separate clean polyethylene bottles. During the sampling period all the necessary precaution were taken. After transportation to laboratory the non-acidified samples were analyzed for physical parameters. Separate samples were collected for chemical and biological analyses for sampling and sample preservation.

Physiochemical parameters of drinking water

The Physico chemical properties viz., pH, temperature, electrical conductivity, turbidity, dissolved solids, calcium, magnesium, alkalinity, total hardness, chlorides and nitrates of the water samples were carried out by the following standard procedure of [APHA, 1998].

Total coliform test

All the drinking water samples collected from the rural areas of Dholpur were analyzed for coliform bacteria. Most probable number (MPN) was used to detect the total coliform in drinking water samples. MPN was determined by Mackie & McCartney, 1996 method. This test is performed sequentially in three stages: presumptive coliformed and complete test. Lactose broth i.e. double-Lactose (LB2×) and single lactose (LB1×) tubes were incubated with different

water volumes (10ml, 1.0ml, 0.1ml) in presumptive test. Tubes that showed positive gas production after 24 hrs incubation at 35^0C were incubated into brilliant green lactose bile broth for confirmed test and probable number (MPN) of coliform bacteria in water samples were collected from calculated the statistical table of Mackie & McCartney 1996.

Results:

Physiochemical parameters of drinking water

In the present investigation, the concentration of the calcium in the water samples at site I, II and III was 62.6 ±1.2, 66.3 ± 0.3, 68.1 ± 0.2, respectively and the amount of magnesium was 16.6 ± 0.3, 18.6 ± 0.11, 20.4 ± 0.01 at site I, II, III, respectively during sampling period. The total hardness of the water samples at the study area was 212.7 ± 1.1, 231.3 ± 0.13, 243.1 ± 0.33 at site I, II, III, respectively. The chloride (mg/L) and nitrate (mg/L) concentration was between 67.1 ± 0.21 to 81.2 ± 0.26 at the study area, respectively during sampling. Chromium (mg/L) of water samples at the study area was found to be 0.01±0.1, 0.01±0.1, 0.02±0.5, at the site I, II and III, respectively during sampling period. Iron (mg/L) of the water samples at the study area was found to be 0.1±0.3, 1.2±0.1, 1.7±0.3, at the site I, II and III, respectively during sampling period. Sodium (mg/L) of water samples at the study area was found to be 18.6±0.19, 21.67±0.38, 12.67±0.19 at the site I, II and III, respectively during sampling period. Potassium (Mg/L) of water samples at the study area was found to be 6.67±0.19, 6.0±0.22, 2.67±0.11 at the site I, II and III, respectively during sampling period (Table 1).

Table 1: Physicochemical parameter of drinking water

Sr. No	Parameter	Site I	Site II	Site III
1	Temperature (^{0}C)	35.2	32.4	33.6
2	EC (mS)	0.42	0.44	0.47
3	Turbidity (NTU)	6	7	8
4	pH	7.8	7.9	7.9
5	Dissolved solids (mg/L)	343.1±0.2	375±0.1	386.1±0.15
6	Calcium (mg/L)	62.6±1.2	66.3±0.3	68.1±0.2
7	Magnesium (mg/L)	16.6±0.3	18.6±0.11	20.4±0.01
8	Alkalinity (mg/L)	169.6±0.12	157.8±0.2	174.2±0.12
9	Total hardness $CaCO_3$ (mg/L)	212.7±1.1	231.3±0.13	243.1±0.33
10	Chlorides (mg/L)	81.2±0.26	76.2±0.02	67.1±0.21
11	Nitrates (mg/L)	6.14±0.2	7.3±0.01	7.21±0.01
12	Iron (mg/L)	0.1±0.3	1.2±0.1	1.7±0.3
13	Chromium (mg/L)	0.01±0.1	0.01±0.1	0.02±0.5
14	Sodium (mg/L)	18.6±0.19	21.67±0.38	12.67±0.19
15	Potassium(mg/L)	6.67±0.19	6.0±0.22	2.67±0.11

Bacterial contamination of drinking water

All drinking water samples collected from Dholpur district were analyzed for coliform bacteria and ranged from (0-5/100mL). Eslampura water samples showed the not detected of coliform bacteria but Bhaudapur water samples showed the presence of coliform bacteria. The higher contamination of drinking water by coliform bacteria was represented by Site I. In Dholpur district, total coliform bacteria in drinking water samples generally exceeded the permissible limit (0-100 mL) set by WHO, 2004 (Table 2).

Table 2: Mean value of coliform bacteria (100ml/MPN) at the study sites

Sr. No.	Village Name	Water Source	Total Coliform
1	Site I	Municipal Water	ND[a]
2	Site II	Municipal Water	2.0±0.01
3	Site III	Municipal Water	1600±1.6

±Standard Deviation; [a] Not detected

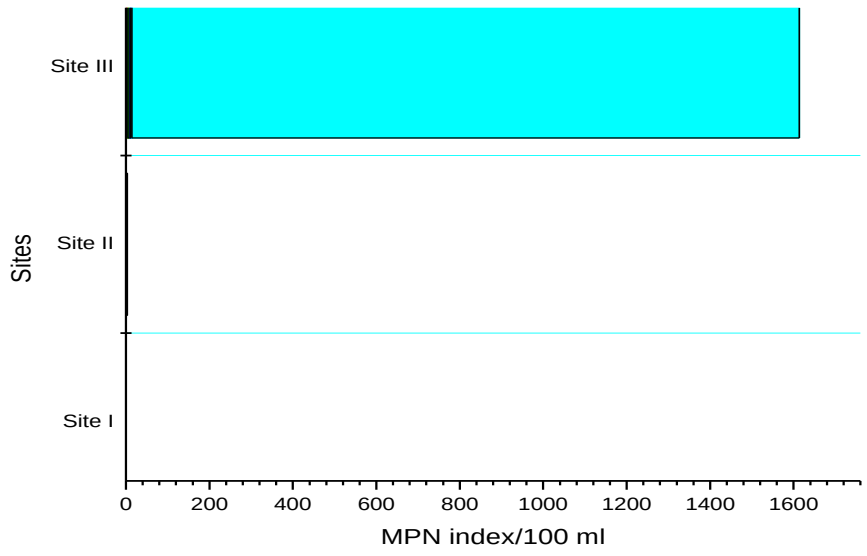

Figure 1: Mean variation of coliform bacteria (100ml/MPN) at the study sites

Table 3: Correlation Coefficients (r) of physico-chemical parameters of municipal water samples Site I

Parameters	Temp	EC	Turb.	pH	TDS	Ca^{+2}	Mg^{+2}	T.A	T.H	Cl^{-}	Nitrate	Fe	Cr	Na^{+}	K^{+}
Temp. (°C)	1														
EC (µmS)	-0.569	1													
Turb.(NTU)	-0.7402	0.1397	1												
pH	0.4443	0.4108	0.7182	1											
TDS (mg/l)	0.0131	-0.0452	0.6520	0.6370	1										
Ca. (mg/l)	-0.4507	0.1338	0.3032	-0.0447	-0.5214	1									
Mg. (mg/l)	0.7387	0.8964	-0.0565	0.3736	0.1375	-0.3153	1								
T.A (mg/l)	0.6886	-0.5210	-0.8988	-0.7117	-0.6003	-0.2273	-0.3476	1							
T.H (mg/l)	-0.6338	-0.6340	-0.8317	-0.7005	-0.5417	-0.2160	-0.4653	0.9901	1						
Cl (mg/l)	-	0.634	0.8511	0.752	0.509	0.2457	0.4398	-	-	1					

	0.3777	4		6	0			0.9850	0.9927						
Nitrate (mg/l)	0.4739	0.7618	-0.2793	0.3314	0.0308	-0.4332	0.9363	-0.0689	-0.8755	0.1821	1				
Fe (mg/l)	0.0160	-0.6764	0.6123	0.9001	0.6521	-0.1563	0.0335	-0.4348	-0.3807	0.4461	0.1001	1			
Cr (mg/l)	0.4121	-0.9128	-0.1020	-0.4909	0.2146	-0.2997	-0.7469	0.3805	0.4836	-0.5319	-0.7121	-0.1666	1		
Na (mg/l)	0.4744	-0.7836	-0.5122	-0.8789	-0.3292	-0.0843	-0.694	0.6892	0.7420	-0.7886	-0.6201	-0.6163	0.8364	1	
K (mg/l)	-0.3263	-0.7905	-0.5303	0.8504	-0.0230	-0.0244	-0.696	0.6967	0.7485	-0.8024	-0.5589	-0.5773	0.8660	0.9912	1

Table 4: Correlation Coefficients (r) of physico-chemical parameters of municipal water samples in Site II

Parameters	Temp	EC	Turb.	pH	TDS	Ca^{+2}	Mg^{+2}	T.A	T.H	Cl^{-}	Nitrate	Fe	Cr	Na^{+}	K^{+}
Temp. (°C)	1														
EC (µmS)	0.9736	1													
Turb.(NTU)	0.5204	0.3118	1												
pH	0.0704	0.2117	-0.4842	1											
TDS (mg/l)	-0.3135	0.4456	-0.3623	0.8625	1										
Ca. (mg/l)	-0.2279	-0.4176	0.6139	-0.3095	-0.2768	1									
Mg. (mg/l)	-0.0878	0.0628	-0.611	0.9181	0.6184	-0.5885	1								
T.A (mg/l)	0.1268	0.2637	-0.4588	0.8185	0.5088	0.4610	-0.2466	1							
T.H (mg/l)	0.5365	0.3442	0.9458	-0.6219	0.5418	-0.0292	0.9488	-0.4191	1						

Cl (mg/l)	0.7245	0.6075	0.7432	-0.3464	-0.3545	-0.4116	-0.6343	0.0136	0.8763	1					
Nitrate (mg/l)	0.3554	0.4227	-0.1020	0.7009	0.3996	-0.9727	-0.2810	0.9303	-0.0708	0.3346	1				
Fe (mg/l)	0.1550	0.3450	-0.6454	0.1704	0.2158	-0.6211	0.8082	0.4023	0.4286	-0.0677	0.1976	1			
Cr (mg/l)	0.3668	0.4665	-0.2182	0.1889	0.3527	-0.4315	0.3036	0.9407	-0.1185	0.3434	0.9688	0.4223	1		
Na (mg/l)	0.1183	0.2735	-0.5306	-0.5976	0.8578	0.6283	0.7870	0.8603	-0.6316	-0.3082	0.7311	0.2936	0.6948	1	
K (mg/l)	-0.5547	-0.6172	0.1690	-0.4517	-0.1689	0.0528	0.9332	-0.7796	0.3350	0.3364	-0.8830	-0.4472	-0.9449	-0.4595	1

Table 5: Correlation Coefficients (r) of physico- chemical parameters of municipal water samples in Site III

Parameters	Temp	EC	Turb.	pH	TDS	Ca^{+2}	Mg^{+2}	T.A	T.H	Cl	Nitrate	Fe	Cr	Na^{+}	K^{+}
Temp. (°C)	1														
EC (µmS)	0.2030	1													
Turb.(NTU)	-0.3942	-0.1386	1												
pH	0.5717	0.4931	-0.6155	1											
TDS (mg/l)	-0.0140	-0.6780	0.4335	-0.7978	1										
Ca. (mg/l)	0.0480	0.8794	0.2365	0.0481	-0.2892	1									
Mg. (mg/l)	0.2514	0.4469	0.1140	-0.3115	0.3214	0.7180	1								
T.A (mg/l)	0.3897	-0.6338	-0.4492	0.3473	0.0902	-0.8840	-0.6497	1							
T.H (mg/l)	0.3340	-0.7366	-0.5014	0.0990	0.3285	-0.8887	-0.4244	-0.4191	1						

Cl (mg/l)	0.0674	-0.4221	-0.5922	0.4980	-0.3293	-0.8000	-0.8484	0.0136	0.7257	1				
Nitrate (mg/l)	-0.3909	-0.0762	0.9727	-0.7145	0.5112	0.3535	0.3217	0.9303	-0.5565	-0.7421	1			
Fe (mg/l)	0.0253	-0.4	-0.7320	0.4109	-0.2573	-0.6529	-0.9297	-0.4572	0.4185	0.7573	-0.2287	1		
Cr (mg/l)	0.8428	0.3162	-0.6577	0.9097	-0.4863	-0.0632	-0.1413	-0.2756	0.3441	0.4514	-0.7233	0.3162	1	
Na (mg/l)	-0.2568	0.4670	0.8096	-0.2879	-0.8763	0.7417	0.3897	0.8603	-0.8927	-0.7973	0.8310	-0.2724	-0.4308	1
K (mg/l)	0.1269	-0.8	-0.1386	-0.4931	0.8098	-0.6396	0.0715	-0.7796	0.7700	0.1738	-0.0762	-0.1	-0.1581	-0.5838	1

Water samples were collected from municipal water supply from residential areas and fifteen Physico- chemical parameters and coliform bacteria were analyzed using standard methods. The result of the analysis were summarized in the (Table-II) and compared with WHO levels. Concentration of the total hardness of the water samples at the study area was found to be 212.7 ± 1.1, 231.3 ± 0.13, 243.1 ± 0.33, at site I, II, III, respectively. The chloride (mg/l) and nitrate (mg/l) concentration was found between 67.1 ± 0.21 to 81.2 ± 0.26 and 6.14 ± 0.2 to 7.3 ± 0.01 at the study area, respectively during sampling period. The interpretation of analytical results of the current study investigate that TSS occurred mainly in the form of carbonates and bi-carbonates and may have been released from the host sedimentary rocks, mainly limestone and dolomite, into the water aquifer in the study area. Such type of dissolved solids were mainly found coarser in size and caused suspension but no turbidity. As a result the pH and turbidity values of all samples in the present study fall within the WHO and Indian Standard for Drinking water [IS: 10500, 1992] permissible limit, The pH of drinking water has no immediate direct effects on human health but has some indirect health effects by bringing changes in other parameters such as solubility of metals and survival of pathogens [Ho *et al.,* 2003]. In sensitive individuals gastrointestinal irritation may also occur, however, occasional pH changes may not have any direct impact on consumers. The chemical parameters including hardness and alkalinity are closely related with each other. The alkalinity of water is a measure of its buffering capacity. The higher the value, the more acid can be neutralized i.e., the more the water can resist a change in pH. Alkalinity of natural water is primarily the result of bicarbonates, but mostly expressed in terms of calcium carbonate. The results of our study found that the pH values of all the samples were recorded below 8.5 and the total hardness and alkalinity values were recorded more or less in the same range. Therefore, it was assumed that the total hardness of the drinking water particularly in samples collected from municipal and ground water due to the presence of carbonates and bicarbonates which causes alkalinity as well as temporary hardness. The principal natural sources of hardness in water are sedimentary rocks and seepage and runoff from soils. In general, hard waters originate in areas with thick topsoil and limestone formations and hardness levels up to several thousand milligrams per liter can result [Sawyer and McCarty, 1967]. The contamination of NO_3 mainly occurs due to overuse of fertilizers, sewage disposal, manure applications and wastewater of livestock farms [Chowdary *et al.,* 2005]. The primary health problem associated with high intake of NO_3 in drinking water is methemoglobinemia (blue baby syndrome) [Gupta *et al.,* 2000]. However, the adult individuals can tolerate high levels of NO_3 with little or no documented adverse health effects and may be able to drink water with nitrate concentrations considerably greater than the 10 mg/L with no acute toxicity effects [Bruning-

Fann and Kaneene, 1993]. Chromium (mg/L) of water samples at the study area was found to be 0.8±0.01, 0.5±0.2, 0.2±0.5, at the site I, II, III, respectively during sampling period. Iron (mg/L) of the water samples at the study area was found to be 1.6±0.3, 1.2±0.1, 1.8±0.3, at the site I, II, III, respectively during sampling period. Some of the symptoms are tiredness, slight abdominal pain, discomfort, and anemia in the case of children behavior may change [Gerlach *et al.*, 2002]. Moderate to low level of exposure may result in hearing loss, inhabit growth, and cause learning disabilities. The symptoms may include cramps, irritability, fatigue, vomiting, sleeping disorder, poor appetite. Chromium compounds are toxins and known human carcinogens, whereas, Chromium is an essential nutrient. Breathing high levels can cause irritation to the lining of the nose, nose ulcers, runny nose and breathing problems, such as asthma, cough, shortness of breath, or wheezing, long term exposure can cause damage to liver, kidneys circulatory and nerve tissues, as well as skin irritation. Iron is essential for human health but is also a toxic metal. Iron can be found dissolved in water that we use for drinking. Excessive ingested iron can cause excessive levels of iron in the blood, because high iron levels can damage the cells of the gastrointestinal tract, preventing them from regulating iron absorption. However, humans experience iron toxicity above 20 milligrams of irons for every kilogram of mass, and 60 milligrams per kilogram is a lethal dose [Sullivan, 1981]. The presence of chloride in drinking water sources can be attributes to the salts depositions found in the rural areas of Dholpur . The presence of high levels of TDS in water sample may be objectionable to consumers owing to the resulting taste and to excessive scaling in water pipes, heaters, boilers, and household appliances. Some dissolved organic matter may contribute to increased levels of TSD which also indicates that water is polluted [Roa *et al.*, 2012]. The accumulation of these heavy metals might be due to anthropogenic activities and important in public health.

Drinking water sources were contaminated with coliform bacteria may be due to leakage pipe lines, lack of sewage and solid waste disposal systems which were the major threat to municipal water supply of Dholpur rural villages. Coliform bacteria may not cause disease, but also used as one of the indicators of pathogenic contamination that can cause diseases such as intestinal infections, dysentery ,hepatitis, typhoid fever, cholera and other illnesses [Emmanuel *et al.*, 2009]. Finally, due to ingestion of contaminated water in the Dholpur rural village Pichor Ki Pahadiya, most residents suffered from water diseases like gastroenteritis , cholera, dysentery, diarrhea and viral fever etc, especially children, as reported during questionnaire survey, significant influx of patient with complains of vomiting, diarrhea also has been reported at local healthcare centers. The government should supply treated/clean water with supply line far away

from solid waste and sewage site. In the study areas while both women and adult girls and children were not educated with the knowledge and management of water must be educated.

The correlation coefficients (r) between various pairs of the Physico-chemical parameters of the municipal water samples from residential areas of Dholpur were furnished in table III, IV and V. The excellent correlation of temperature with pH (0.4443), TDS (0.0131), Mg^+ (0.7387), TA (0.6886), Nitrate (0.4739), Fe (0.0160) which satisfies the experimental results of the sources of drinking water at site I. Garg [2004] observed strong correlation of TDS with anions – F^- (0.208), HCO_3^- (0.706), Cl^- (0.145). Similar type of positive correlation of other parameters analyzed at the site I, II and III. Turbidity is negatively correlated with total alkalinity (-0.8988). Similar type of correlation was observed between total hardness and Chromium (-0.5319) in the drinking water at site I. Therefore, the determination of correlation coefficient analysis can be used as an important method for the interpretation among the Physico- chemical parameters and pollution levels of the various drinking water samples of the locality. The coliform bacterial contamination (2-1600 MPN/100 mL) was also found in some sources of water, confirming the bacterial contamination of drinking water. Water contamination with coliform bacteria was main source of water borne diseases like diarrhea, depression, anemia, vomiting, kidney problems, abdominal pain, poor appetite, gastrointestinal problems and dysentery. In the study area, improper condition of piping network and transportation were also the major sources responsible for contamination of drinking water.

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ANALYSIS OF SOME CHEMICAL PARAMETERS OF A WETLAND ECOSYSTEM, GONDIA, DIST. GONDIA, (M.S.)

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Introduction:

Besides survival, water is very essential for irrigation, industries, municipal waste, fisheries, etc. agricultural runoff, various chemicals enter in water bodies that changes water quality and physico-chemical parameters of lakes. Pesticides and heavy metals from agricultural and industrial effluents cause adverse effects on the aquatic animals.

Many nutrients such as Nitrogen and Phosphorus inputs from domestic sewages and fertilizers increase the eutrophication of water bodies (Vass *et al.*, 1989). Lakes are most important ecosystems which plays important role in the life of aquatic animals. They are characterized by distinct biotic and abiotic environment which plays vital role to the maintain ecological balance of flora and fauna and their interrelationship regulate surrounding climate and recharge ground water, but unfortunately, they are dying.

Analysis of some chemical parameters are very useful in assessing the deterioration of water quality and to check the water pollution and the importance is highlighted since the time of applied hydrobiology has a great scope in the healthy existence of inland aquatic ecosystems and in harvesting the natural resources at sustainable level (Goldman and Horne, 1983).

Material and Methods:

Chemical parameters like dissolved oxygen, free carbon dioxide, chloride, and nutrients like phosphates and nitrates were studied according to (Welch, 1952) and (APHA, 1975). Water samples for some chemical parameters are carried to the laboratory and few of the parameters are already analyzed on the study area and also analyzed by using some other standard manuals.

Results and Discussion:

Dissolved oxygen:

Dissolved oxygen is considered to be lone factor which reveals the nature of the whole aquatic system at a glance, even without the assessment of other physico-chemical and biological parameters. In the water containing large quantity of animals and vegetables decaying matter,

there is great shortage of oxygen, of which the most part is being used up in the process of decomposition (Tonapi, 1980).

Railway Station Pond showed minimum DO in the month of May with 2.8 mg/lit. while maximum in December with 6.0 mg/lit. during the study. (Ingole et. al, 2009) reported the DO is essential for growth of algae and fish production. He has recorded higher concentration during winter and early monsoon months and is correlated by its inverse correlation with water temperature. He has observed minimum DO of 3.0 mg/l in summer and maximum of 10.3 mg/l in winter. (Shastri, 2005) has reported, that is similar results, the minimum DO (4.4 mg/l.) was reported in the summer. Depletion of oxygen in water might be due to addition of sewage. (Thirupathaiah et. al, 2012) reported higher value of dissolved oxygen in winter season while lower value of in summer season in lower man air reservoir of Karimnagar district, Andhra Pradesh.

Free carbon dioxide:

CO_2 is an end product of both aerobic and anaerobic bacteria oxidation; therefore its concentration is not limited by the amount of dissolved oxygen. Surface water normally contain less than 10 mg/lit free CO_2.The CO_2 content of water depend upon the temperature of water, depth of water, rate of respiration, decomposition of organic matter and chemical nature of the bottom.

In the present study, the minimum free CO_2 was recorded as 2.7 mg/lit. in the month of November and maximum of 12.5 mg/lit. during the summer. (Bose et. al, 2008) in two fresh water ponds in Dhanbad, Jharkhand, has also reported minimum value of free CO_2 during winter season.

Total alkalinity:

A number of bases such as carbonates, bicarbonates, Hydroxide, phosphates, nitrates, silicates, borates etc. contribute to the alkalinity. Thus alkalinity may be expressed as total alkalinity or due to individual bases. Studies showed maximum value of alkalinity during summer season of the study year and minimum during the monsoon (Mukherji et. al, 2006) reported the maximum total alkalinity in summer with the increase in temperature. (Chandrasekhar, 2006) in Kondakarla lake, A.P. reported minimum total alkalinity during monsoon and maximum during summer season. (Manjare *et al.,* 2010) also noted similar results that it was higher in summer and lower in monsoon.

Chloride:

Chloride is universally present in soil and mostly as a soluble ion. The high Chloride concentration is considered to be an indicator of pollution due to organic wastes of animal origin.

The animal excreta contain high quantity of Chloride along with nitrogenous wastes. Most of the lakes and ponds receive Chlorides by leaching through soils and also with runoff from catchment area.

In present study, the minimum Chloride content was recorded in the month of May (2.49 mg/ lit) and the maximum in the month of August (79.48 mg/ lit) in this wetland ecosystem. The maximum chloride content was found during monsoon season due to high quantity of organic waste of animal origin. (Sakhare, 2005) in Hingani reservoir, Pangaon reported minimum chloride content during the summer season. (Chalkoo, 2007) in Wular lake also reported the maximum chloride content during monsoon season.

Nitrates:

Though nitrogen is a major constituent of atmosphere, it is also found in small amount in the form of ammonia, nitrates, nitrites, organic nitrogen and so on. Maximum value was observed in the Railway station pond in the month of May (4.25 mg/lit) and minimum in the month of December (2.90 mg/lit). In the ponds of Indian deserts, (Sharan et.al,2007) reported minimum nitrates in December during winter (0.396 mg/l.) and maximum in the month of April during summer (0.960 mg/l.). (Dutta et. al, 2007) also reported maximum nitrates in April (0.45 mg/l.) in ox-bow lakes, Assam. lower nitrate values were recorded during winter which may be attributed to the abundance of phytoplankton activities of denitrifying bacteria, more quantity of water diluting the pollutants to some extent and decreased activity of microbes at lower temperature. However, higher values in this ecosystem recorded during summer season might be due to the presence of higher concentration of nitrogen fixing algae, low water level, more input of nitrogenous effluents.

Phosphates:

Phosphorus bound to rocks is generally insoluble in water so in natural water its content is low. Domestic and industrial effluents and agriculture run off are major sources of Phosphorus in water hence its high concentration indicates the pollution. The value of phosphates ranges from 3.45 to 10.12 mg/l. The highest value recorded in the pond might be due to high input of domestic sewage, agricultural runoff and anthropogenic activities. Minimum phosphate value during winter may be due to its utilization in macrophytic growth and its sedimentation in the form of ferric complexes in soil due to lower calcium lever and lower temperature, where as higher values during summer can be attributed to high wind speed, decrease in water level due to higher evaporation rate and decomposition of algal population. (Maganur, et. al, 2008) also recorded minimum phosphates during winter in Ranebennur pond, Haveri distt. Karnataka.

(Ujjainia *et al.*, 2007) in different water bodies from S. Rajasthan observed high value of phosphate during summer season.

Summary:

Ponds and lakes are considered as natural resources and wetland ecosystems. The management of such wetlands has become the need of the hours as community activity and other sources of pollution as enumerated in the present study can alter limnological characteristics. Community activities such as bathing, cleaning, household activities, washing of the livestock, will increase the nutrient load. This may be stopped and some other alternative may be made for this to reduce the nutrient loads. Desilting of this wetland ecosystem may be emphasized an some alternatives could be worked out in collaboration with local municipality for diversion of untreated domestic sewage and slaughterhouse wastes and means to restore recreational activities in this ecosystem. Solid waste dumping should be prevented.

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