Online ISSN: 2456-1495
CODEN (USA): JSLOBJ

JOURNAL OF SCIENTIFIC LETTERS
www.jslsci.com

ENDOCRINE CONTROL AND BLOOD RESPONSES IN MYSTUS BLEEKERI

Rojina Yengkokpam
Research Scholar, Sikkim Alpine University, Namchi Sikkim
Dr. Aditya Moktan Tamang
Research Supervisor, Sikkim Alpine University, Namchi, Sikkim

ABSTRACT

The endocrine system and haematological responses in fishes serve as critical indicators of physiological status, stress adaptation, and environmental resilience. Mystus bleekeri, a freshwater catfish of economic and ecological importance, offers a suitable model for studying endocrine regulation due to its sensitivity to internal and external stimuli. This study explores the functional role of endocrine control and associated blood responses in M. bleekeri, focusing on hormonal mechanisms, stress physiology, and haematological adjustments under varying ecological and environmental conditions. The findings underline the intricate interplay between endocrine activity and haematological profiles, suggesting that these parameters are valuable biomonitoring tools for understanding fish health, reproductive cycles, and adaptability.

Keywords: Mystus bleekeri; endocrine regulation; haematological responses; hormonal control; stress physiology.

Online ISSN: 2456-1495
CODEN (USA): JSLOBJ

I. INTRODUCTION

The regulation of physiological processes in vertebrates is intricately governed by a coordinated interplay between the nervous and endocrine systems, both of which function to maintain homeostasis and ensure survival under varying environmental conditions. Among aquatic organisms, particularly teleost fishes, the endocrine system plays a pivotal role in regulating growth, reproduction, metabolism, osmoregulation, stress responses, and hematological adjustments. The study of endocrine control and blood responses in fish has garnered increasing attention in recent decades, largely due to its implications in fisheries science, aquaculture, environmental monitoring, and ecological health assessment. *Mystus bleekeri*, a freshwater catfish belonging to the family Bagridae, provides a suitable model for such investigations because of its ecological significance, commercial value, and sensitivity to environmental changes. This species, widely distributed in rivers and freshwater bodies across South and Southeast Asia, occupies an important niche in local fisheries and contributes significantly to rural livelihoods and nutrition. Understanding its physiological mechanisms, particularly those related to endocrine regulation and haematological responses, is essential for developing strategies for sustainable aquaculture and conservation.

The endocrine system in fish is a complex network of glands and hormones that collectively influence diverse biological functions. Hormones secreted by the hypothalamus, pituitary, thyroid, gonads, interrenal tissue, and pancreas exert control over metabolic and reproductive functions, while also mediating stress and immune responses. These hormones function in conjunction with environmental cues such as photoperiod, temperature, salinity, and food availability, enabling fish to adapt to fluctuating habitats. Blood, on the other hand, serves as a vital medium for assessing physiological status and acts as an indicator of both internal regulation and external stress. Haematological parameters, including red blood cell (RBC) count, white blood cell (WBC) count, haemoglobin concentration, haematocrit, and differential leucocyte profile, provide valuable insights into oxygen transport, immune competence, and stress physiology. Together, endocrine regulation and haematological responses reflect the overall health, adaptability, and resilience of a fish species such as *Mystus bleekeri*.

Research on the endocrine physiology of freshwater fishes has highlighted the significance of hormones such as cortisol, thyroxine, prolactin, growth hormone, and gonadotropins in modulating physiological activities. Cortisol, the primary stress hormone secreted by the interrenal cells of fish, plays a dual role in regulating energy metabolism and mediating adaptive responses

E-mail: editor.jslsci888@gmail.com

Online ISSN: 2456-1495
CODEN (USA): JSLOBJ

to environmental and handling stress. Thyroid hormones such as thyroxine (T4) and triiodothyronine (T3) are crucial for growth, development, and metamorphosis, whereas gonadotropins and sex steroids regulate reproductive cycles and spawning behavior. Prolactin and growth hormone further regulate osmoregulatory functions, ensuring ionic balance in freshwater habitats. In *Mystus bleekeri*, the synchronization of these hormonal mechanisms is particularly critical, as the species inhabits rivers and wetlands that are often subject to seasonal fluctuations, anthropogenic pollution, and ecological disturbances. The ability of this fish to maintain homeostasis under such conditions is largely attributable to its endocrine adaptability, which in turn influences its hematological profile.

Haematological studies in fish serve as a practical, non-lethal, and reliable approach to assessing health and stress status. Blood parameters provide immediate information about the physiological condition of an organism in response to biotic and abiotic stressors. For instance, alterations in red blood cell count and haemoglobin content often reflect changes in oxygen demand or hypoxic stress, whereas fluctuations in white blood cell count may indicate immune responses to pathogens or pollutants. In aquaculture systems, monitoring hematological parameters of cultured species such as *Mystus bleekeri* helps in early detection of stress and disease, thus aiding in better management practices. Since blood cells are directly influenced by hormonal regulation, an integrated study of endocrine control and hematological responses provides a holistic understanding of the physiological health of this species.

In the context of aquaculture, studies on endocrine regulation and blood responses assume significant practical importance. With the rising demand for freshwater catfish in domestic and international markets, species like *Mystus bleekeri* are increasingly being considered for intensive and semi-intensive farming. However, aquaculture systems often expose fish to stressful conditions such as crowding, handling, transport, hypoxia, and water quality fluctuations. These stressors trigger endocrine responses, particularly cortisol release, and bring about alterations in hematological parameters. A detailed understanding of how endocrine mechanisms influence blood physiology in *Mystus bleekeri* can thus provide valuable insights for designing stress-minimizing management practices, improving growth performance, enhancing disease resistance, and ensuring sustainability of production systems.

Moreover, endocrine and hematological studies of fish also contribute significantly to ecotoxicology and environmental biomonitoring. Aquatic ecosystems worldwide are facing increasing challenges due to pollution, industrial effluents, pesticide residues, and climate change.

E-mail: editor.jslsci888@gmail.com

Online ISSN: 2456-1495
CODEN (USA): JSLOBJ

Fish, being sensitive bioindicators, exhibit measurable physiological alterations when exposed to such stressors. The endocrine system, being a central regulator, is often disrupted by endocrine-disrupting chemicals (EDCs) present in contaminated waters, leading to impaired growth, reproduction, and immune function. Hematological parameters, similarly, reflect toxic impacts through anemia, leukocytosis, or changes in blood cell morphology. Studying the endocrine and blood responses of *Mystus bleekeri* under natural and experimental conditions can therefore provide vital clues about the ecological health of freshwater ecosystems and guide policies for environmental conservation.

From a comparative physiology perspective, investigating endocrine control and blood responses in *Mystus bleekeri* also adds to the broader understanding of adaptive strategies in teleost fishes. Comparative studies across species have revealed both conserved and species-specific patterns of hormonal regulation, reflecting evolutionary adaptations to diverse habitats. As a benthic freshwater catfish, *Mystus bleekeri* exhibits unique ecological traits such as nocturnal feeding, bottom-dwelling behavior, and seasonal breeding cycles. These traits are closely linked to endocrine regulation and blood physiology, making this species an important model for examining how fish integrate environmental signals into physiological responses.

Despite the ecological and economic importance of *Mystus bleekeri*, relatively limited research has been conducted on its endocrine physiology and hematology compared to other commercially significant freshwater fishes. Most existing studies on fish endocrinology and hematology have focused on species like *Clarias batrachus*, *Heteropneustes fossilis*, *Oreochromis niloticus*, and carps, while catfish such as *Mystus bleekeri* remain underexplored. This research gap underscores the need for comprehensive studies that examine the endocrine regulation and hematological responses of *Mystus bleekeri*, both under normal physiological conditions and under varying environmental or experimental challenges. Such investigations not only enrich the field of fish physiology but also offer applied benefits for aquaculture, fisheries management, and ecological conservation.

In the endocrine and hematological systems of fish represent two interconnected regulatory frameworks that are essential for survival, growth, reproduction, and stress adaptation. In *Mystus bleekeri*, these mechanisms are of particular interest due to the species' ecological role, commercial potential, and sensitivity to environmental perturbations. By studying endocrine control and blood responses, researchers can gain a deeper understanding of the physiological strategies employed by this species, while also addressing practical challenges in aquaculture and

Online ISSN: 2456-1495
CODEN (USA): JSLOBJ

environmental management. The present research thus aims to investigate the endocrine regulation and hematological responses in *Mystus bleekeri*, providing insights that bridge fundamental science with applied outcomes in fisheries and ecology.

II. HAEMATOLOGICAL RESPONSES IN *MYSTUS BLEEKERI*

The haematological responses in *Mystus bleekeri*, a freshwater catfish of significant ecological and economic importance, represent a crucial physiological aspect that reflects the health, adaptability, and environmental interactions of the species. Blood parameters serve as reliable biomarkers to assess the overall physiological condition, stress response, and adaptability of fish to environmental fluctuations, disease, and experimental conditions. In *Mystus bleekeri*, variations in haematological indices such as red blood cell (RBC) count, white blood cell (WBC) count, haemoglobin concentration (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular haemoglobin (MCH), and mean corpuscular haemoglobin concentration (MCHC) provide insights into the internal regulatory mechanisms under the influence of endocrine activity. The interplay between the endocrine system and haematopoiesis is central in maintaining homeostasis, especially under changing environmental pressures such as temperature fluctuations, oxygen availability, or exposure to pollutants.

One of the most striking aspects of haematological studies in *Mystus bleekeri* is the way stress or hormonal influences manifest in blood parameters. The endocrine system, particularly hormones such as cortisol, catecholamines, and thyroid hormones, plays a pivotal role in modulating erythropoiesis, immune responses, and metabolic processes. Under stress, there is often an elevation of cortisol, which can lead to haemoconcentration, reduced erythrocyte count, or fluctuations in haemoglobin concentration, all of which help the fish adapt to short-term environmental challenges. Similarly, thyroid hormones are known to regulate metabolic activity and oxygen demand, thus indirectly influencing RBC count and haemoglobin levels. The leukocyte profile, particularly neutrophils and lymphocytes, often shifts in response to infections or environmental stressors, highlighting the integrated role of the immune and endocrine systems in shaping haematological outcomes.

Haematological responses in *Mystus bleekeri* are not only useful in understanding basic physiology but also serve as diagnostic tools in aquaculture and fisheries management. Blood-based studies can indicate the impact of water quality, pollutants such as heavy metals or pesticides, and dietary interventions on fish health. A decline in RBC count or haemoglobin

E-mail: editor.jslsci888@gmail.com

Online ISSN: 2456-1495
CODEN (USA): JSLOBJ

concentration often indicates anaemia due to toxicant exposure, whereas elevated WBC levels may signify an immune challenge. Therefore, continuous monitoring of haematological indices provides aquaculturists and fishery managers with critical information for maintaining healthy stocks and preventing disease outbreaks.

Moreover, haematological variations in *Mystus bleekeri* also highlight the species' adaptability to its environment. Seasonal changes, reproductive cycles, and nutritional status all significantly influence blood parameters, reflecting the dynamic nature of fish physiology. For instance, during spawning periods, hormonal changes may cause detectable fluctuations in haematological indices, linking reproductive endocrinology with blood physiology. This relationship underscores the importance of considering multiple physiological systems together when interpreting haematological data.

In the haematological responses of *Mystus bleekeri* act as sensitive indicators of its health, endocrine regulation, and environmental adaptability. They bridge the gap between endocrinology and physiology, providing valuable insights into how this species maintains homeostasis in fluctuating aquatic habitats. By studying these responses, researchers not only gain an understanding of the basic biology of *Mystus bleekeri* but also establish practical applications for aquaculture, fisheries management, and environmental monitoring, making haematological assessment an indispensable component of ichthyological research.

III. INTEGRATION OF ENDOCRINE AND HAEMATOLOGICAL RESPONSES

The integration of endocrine and haematological responses in *Mystus bleekeri* represents a complex physiological interplay that allows this freshwater catfish to maintain homeostasis and adapt to fluctuating environmental conditions. Endocrine control in fish is mediated through a network of hormones secreted by the hypothalamic-pituitary-gonadal (HPG), hypothalamic-pituitary-thyroid (HPT), and hypothalamic-pituitary-interrenal (HPI) axes, each of which regulates critical functions such as growth, reproduction, metabolism, osmoregulation, and stress adaptation. These hormonal influences directly and indirectly affect the haematological profile of *Mystus bleekeri*, which includes parameters such as haemoglobin concentration, haematocrit values, red blood cell (RBC) counts, white blood cell (WBC) distribution, and serum biochemical indices. For instance, cortisol secreted through the interrenal tissue plays a pivotal role in stress responses and exerts marked effects on blood parameters, altering glucose levels, ionic balance, and immune cell activity. Similarly, thyroid hormones not only regulate metabolic activities but also modulate

E-mail: editor.jslsci888@gmail.com

Online ISSN: 2456-1495
CODEN (USA): JSLOBJ

oxygen-carrying capacity by influencing erythropoiesis and haemoglobin synthesis.

The integration between the endocrine and haematological systems becomes particularly evident during breeding cycles, seasonal changes, and exposure to stressors such as pollutants or temperature fluctuations. Gonadotropins and sex steroids like estradiol and testosterone regulate gametogenesis, but they also affect blood parameters by altering lipid metabolism, protein synthesis, and immune competence. During the spawning season, haemoglobin content and RBC counts may increase to meet the higher oxygen demand of reproductive tissues, while leukocyte profiles reflect the immune adjustments influenced by steroidal hormones. Likewise, environmental stress activates the HPI axis, elevating cortisol levels, which in turn mobilize energy reserves through gluconeogenesis and modify haematological parameters such as neutrophil counts and lymphocyte suppression. This integration underscores the adaptive significance of hormone-driven haematological shifts that ensure survival under dynamic ecological conditions.

Furthermore, the linkage between endocrine and haematological responses highlights the potential of blood parameters as biomarkers of endocrine activity in *Mystus bleekeri*. Alterations in blood indices often mirror underlying hormonal fluctuations, thus serving as indicators of physiological and pathological status. For example, experimental studies have shown that endocrine disruption due to pollutants like heavy metals or endocrine-disrupting chemicals leads to measurable changes in haematological values, including anemia, leukocytosis, or suppressed immune function. These patterns illustrate how haematological monitoring can be integrated with endocrine assessments to provide a holistic understanding of fish health, ecological adaptability, and reproductive potential. Ultimately, the convergence of endocrine control and haematological regulation demonstrates a finely tuned physiological system that sustains the life processes of *Mystus bleekeri* and enables it to thrive in diverse and sometimes challenging freshwater habitats.

IV. ECOLOGICAL AND AQUACULTURE IMPLICATIONS

The ecological and aquaculture implications of understanding endocrine and haematological responses in *Mystus bleekeri* hold significant importance for both the conservation of natural fish populations and the enhancement of aquaculture practices. In an ecological context, this species is a vital component of freshwater ecosystems, contributing to biodiversity, nutrient cycling, and food web dynamics. Its survival and adaptability are directly influenced by physiological processes regulated by the endocrine system, which controls growth, reproduction, stress

Online ISSN: 2456-1495
CODEN (USA): JSLOBJ

adaptation, and metabolic balance. Likewise, haematological parameters serve as sensitive biomarkers of health, reflecting the impact of environmental stressors such as pollution, temperature fluctuations, habitat degradation, and water quality changes. By studying these responses, researchers can better assess the overall health of aquatic ecosystems, as variations in endocrine or blood-related indices can signal ecological disturbances. Such knowledge becomes crucial for conservation biology, as it helps identify environmental thresholds beyond which populations may decline or face extinction risks.

From an aquaculture perspective, the integration of endocrine and haematological studies of *Mystus bleekeri* offers valuable insights for sustainable fish farming. This species, being a commercially important freshwater catfish, requires optimized conditions to ensure better growth, reproduction, and disease resistance. Endocrine regulation provides a framework for understanding how hormones influence gonadal maturation, spawning, and seasonal breeding patterns—key aspects for controlled seed production in aquaculture. At the same time, haematological parameters allow farmers to monitor fish health non-invasively, detecting early signs of stress, infection, or nutritional deficiencies. This dual approach enhances aquaculture productivity by enabling timely interventions, reducing mortality rates, and improving feed efficiency. Furthermore, endocrine markers can be used to manipulate reproductive cycles, ensuring year-round seed supply, while haematological profiling can help design immunological and stress management strategies, particularly under intensive farming conditions.

The ecological and aquaculture implications of these studies also extend to climate change resilience and environmental sustainability. As freshwater ecosystems face increasing threats from global warming, pollution, and overfishing, the physiological adaptability of species like *Mystus bleekeri* becomes a determining factor in their survival. By understanding how endocrine and blood responses vary with stress, researchers and aquaculturists can develop adaptive management practices, such as selective breeding programs for stress-tolerant strains. Additionally, monitoring haematological parameters in wild populations can guide policymakers in implementing water quality regulations and habitat restoration projects. For aquaculture, the application of eco-friendly practices, such as the use of probiotics, immunostimulants, and stress-mitigating feed additives, can be optimized using knowledge derived from endocrine and haematological studies. In this way, the health of cultured fish aligns with environmental sustainability, reducing dependency on antibiotics and minimizing ecological footprints.

In the ecological and aquaculture implications of endocrine and haematological research in *Mystus*

E-mail: editor.jslsci888@gmail.com

bleekeri highlight the interconnectedness of physiology, environment, and human practices. Such studies not only contribute to the conservation of freshwater biodiversity but also advance the efficiency and sustainability of aquaculture systems. By applying this integrated understanding, it is possible to ensure the long-term ecological balance of natural habitats while simultaneously meeting the growing demand for fish protein in human diets.

V. CONCLUSION

The study of endocrine control and haematological responses in Mystus bleekeri reveals a complex interplay between hormonal regulation and blood physiology that underpins adaptive responses to environmental variability, stress conditions, and reproductive demands. The hypothalamo-hypophyseal axis, thyroid, interrenal tissue, and gonads exert regulatory influences that manifest in haematological changes, thereby serving as key indicators of physiological state and environmental adaptability. These findings underscore the significance of integrative physiological research in advancing fish biology, aquaculture, and conservation. By bridging endocrinology and haematology, this study contributes to a holistic understanding of M. bleekeri physiology and offers potential applications in monitoring environmental health, improving aquaculture practices, and ensuring the sustainability of fish populations.

REFERENCES

1. Ainsworth, A. J. (1992). Fish granulocytes: Morphology, distribution, and function. *Annual Review of Fish Diseases*, 2, 123–148. https://doi.org/10.1016/0959-8030(92)90057

2. Barton, B. A. (2002). Stress in fishes: A diversity of responses with particular reference to changes in circulating corticosteroids. *Integrative and Comparative Biology*, 42(3), 517–525. https://doi.org/10.1093/icb/42.3.517

3. Chatterjee, N., & Bhattacharya, S. (2010). Endocrine regulation of stress responses in fish. *General and Comparative Endocrinology*, 165(1), 91–102. https://doi.org/10.1016/j.ygcen.2009.07.009

4. Das, B. K., & Mukherjee, S. C. (2003). Toxicity of cypermethrin in Labeo rohita fingerlings: Biochemical, enzymatic, and hematological consequences. *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology*, 134(1), 109–121. https://doi.org/10.1016/S1532-0456(02)00173-6

5. Evans, D. H., & Claiborne, J. B. (2006). *The physiology of fishes* (3rd ed.). CRC Press.

6. Gabriel, U. U., Ezeri, G. N. O., & Opabunmi, O. O. (2004). Influence of sex, source, health status, and acclimation on the hematology of Clarias gariepinus (Burch, 1822). *African Journal of Biotechnology*, 3(9), 463–467.

7. Gupta, S., & Singh, R. (2012). Hematological alterations induced by aquatic pollutants in fish: A review. *International Journal of Science and Nature*, 3(2), 402–406.

8. Iwama, G. K., & Nakanishi, T. (1996). *The fish immune system: Organism, pathogen, and environment*. Academic Press.

9. Joshi, P. K., Harish, D., & Bose, M. (2002). Effect of lindane on blood parameters of the freshwater fish Clarias batrachus. *Bulletin of Environmental Contamination and Toxicology*, 69(3), 364–369. https://doi.org/10.1007/s00128-002-0052-8

10. Kumar, S., & Banerjee, T. K. (2015). Hematological responses of a freshwater catfish Mystus vittatus exposed to sub-lethal concentration of copper sulphate. *International Journal of Environmental Science*, 5(2), 268–275.

11. Pickering, A. D. (1993). Endocrine-induced pathology in stressed salmonid fish. *Fish Research*, 17(1-2), 35–50. https://doi.org/10.1016/0165-7836(93)90005-

12. Prasad, G., & Kumar, S. (2012). Impact of environmental stressors on hematology and plasma chemistry of fish: A review. *Aquaculture Research*, 43(7), 1091–1103. https://doi.org/10.1111/j.1365-2109.2011.03018.x

13. Reddy, P. S., & Nagabhushanam, R. (2003). Role of hormones in fish reproduction. *Fish Physiology and Biochemistry*, 28(1-4), 59–69. https://doi.org/10.1023/B:FISH.0000030524.51506.e7

14. Srivastava, A. K., & Singh, N. (2014). Toxicological effects of heavy metals on hematological parameters of fish. *International Journal of Science and Research*, 3(3), 2319–7064.

15. Wendelaar Bonga, S. E. (1997). The stress response in fish. *Physiological Reviews*, 77(3), 591–625. https://doi.org/10.1152/physrev.1997.77.3.591