

# **International Research Journal of Management Science & Technology**



**ISSN 2250 – 1959(Online)  
2348 – 9367 (Print)**

*An Internationally Indexed Peer Reviewed & Refereed Journal*

[www.IRJ MST.com](http://www.IRJ MST.com)  
[www.isarasolutions.com](http://www.isarasolutions.com)

Published by iSaRa Solutions

---

## Parthenium Induced Stress in Freshwater Mussels

**Dr. Amit Sharma**

*Asst. Professor,  
Department of Zoology,  
School of Applied Sciences,  
SVU, Gajraula, Amroha, U.P., India*

**Renu Bhatnagar**

*Research Scholar*

### Abstract

*Parthenium hysterophorus* L., is an erect and highly branched annual or ephemeral vegetation that belongs to the Asteraceae family (tribe: Heliantheae). It is notorious for its potential environmental, medicinal, and agricultural hazards. The aim of the study is to assess the *Parthenium* induced stress in freshwater (FW) mussels. Consequently, the present investigation employed insecticides of the pyrethroid and organophosphorous chemical classes, specifically Parthenin. The low human toxicity and affordable cost of both of these chemicals have made them widely used. The toxicity of the aforementioned pesticides to bivalve species is not well-documented. The histological architecture of the digestive gland demonstrated a hike in the lumen size of the digestive tubules, a hike in the number of spaces in the inter-tubular connective tissues (CTs), along with a derangement of the basement membrane. Additionally, a few tubules happened to be ruptured, and epithelial cells were deranged in comparison to the control. Results depicted that after a period of exposure, they are unable to demonstrate any motivation. The bivalve's demise was evidenced by its reduced foot and opened shell valves.

**Keywords:** Stress, *Parthenium*, FW mussels, Toxicity

### Introduction

FW mussels are a species that is both significant and in danger. These bivalve molluscs exist as a renewable resource that sustains a shell industry inside the United States, which is estimated to be worth approximately \$50 million annually. Also, mussels, a food source for other animals, assist in the stabilisation of stream detritus and the filtration of pathogens and contaminants from water. Regrettably, 35 species are extinct, and 70 of the nearly 300 native species to the United States are federally listed as threatened or endangered. The current work is crucial in establishing a foundation of scientific data regarding the impact of pollutants on mussels, as water pollution is a primary source of their decline. (Baruah et al., 2024).

The aquatic food chain is enriched by the pesticides that reach the aquatic ecosystem as a result of the bioaccumulation, bio-concentration (conc.), and bio-magnification process. FW mussels' tissues' biochemical (biochem.) constituents, such as the gills, digestive tract, foot, and mantle, are of vital metabolic significance, and any duress on the animal is reflected in the alterations in these constituents. During periods of duress, an organism requires an adequate amount of energy, which is derived from reserve materials such as glycogen, lipids, and protein (Wang et al., 2024).

Through the production of reactive oxygen species (ROS), pesticides may induce oxidative stress (OS). ROS happen to be highly reactive molecules that indiscriminately interact with essential

macromolecules, including DNA, protein, and lipids, resulting in the disruption of physiological processes (Kumar and Aggarwal, 2024).

One of the molecular mechanisms implicated in toxicity produced by plants i.e, parthenin is lipid peroxidation. Parthenin are not extremely selective; however, they are generally deleterious to a wide range of macrophytes, including non-target organisms (NTOs) like fish and mussels. The catabolism of food is the source of energy required for maintenance and activity. Glycogen is a critical nutrient reserve inside animal tissues, and it is utilised as a readily available energy source when necessary. Consequently, glycogen is a critical component of the typical metabolism of an organism (Kumari et al., 2024).

Carbon compounds are essential for all biomolecules, and carbohydrates are a significant source of energy. Some polysaccharides are used to store chemical energy, while others are used to form structural components. Acute and Long-Term Impact of Cotton Azo Dyes on Glycogen and Glucose Levels (lvl.) in the Foot, Mantle, and Hepatopancreas of the FW Snail *Pila globosa*. The impact of hildan has been observed on metabolic depression in the FW bivalve *Lamellidens corrianus* (Wang et al., 2024). The accumulation of a significant amount of data on phylum's various biochem. features has been a consequence of the significant interest in molluscs, which are the source of sustenance for humans. It is crucial to possess an understanding of the chemical composition of any edible organism, as the biochem. contents are indicative of its nutritional value. the total protein modifications in the tissue of the FW mollusc that occurred as a result of cyper kill exposure. The impact of a sublethal conc. of toxic substance were on the protein, lipid, and glycogen lvl.s of the mussels. The impact of endosulfan exposure on the protein content (PC) of *Lamellidens marginalis* (Dias et al., 2021).

Changes in the PC of the FW bivalve *Parreysia cylindrica* in response to nickel chloride along with lead chloride exposure. the impact of Organophosphate (Nuvan) on the PCs of the gills and liver of *Rasbora daniconius*. An analysis and comparison of the protein profiles of various tissues, including the gills, foot, and mantle, of two FW bivalves, *L. corrianus* and *L. marginalis*. They identified protein markers that are useful for the study of molluscan taxonomy. Protein happens to be the most essential nutrient for the growth, development, and preservation of life (Dias et al., 2021). The PC of various organs in bivalve has been reported to be altered by toxicants like heavy metals and organophosphorus pesticides in numerous studies. The ameliorative effects of L-ascorbic acid on the PCs of *Lamellidens marginalis* (Lamarck), a FW bivalve, that were induced by profenofos (Sharma et al., 2024).

Lipids were employed as an energy source subsequent to glycogen. Glycerol and esters are the forms in which lipids are stored and transported, serving as an energy reservoir. The cellular and subcellular membranes are also reliant on lipids. Endosulfan's impact on the cholesterol and lipid content of land snail *L. alte* (Balamurigan and Chakravarthy, 2024).

Enzymes "increase the rate of reaction without their own undergoing any overall changes". Consequently, any alteration to the enzyme pattern may have a significant impact on the living organisms. Several NTOs in the aquatic environment were unintentionally exposed to pesticides. These pesticides subsequently pose a threat to aquatic animals by disrupting enzymatic activities, which leads to biochem. along with physiological changes in the bodies of NTOs. The characteristics of a specific pollutant are likely to be the cause of a physiological change (Ahmed and Rahman, 2024).

Phosphatases (Pase) are categorised into two primary groups: acid Pase along with alkaline Pase, which are determined by their optimal pH. Toxic substances' incorporation into the body of an animal results in modifications to the activities of said enzymes. Pases are hydrolytic enzymes. They eliminate inorganic phosphate from specific organic phosphate esters, including nucleotides, glycerophosphatase, and hexose Pase (Dias et al., 2021).

Crops along the Ganges, India, are infested by mature fruiting stages. The Asteraceae (Compositae) is the most extensive family of flowering plants, with over 23,600 species that are distributed globally (Encyclopaedia of Life, 2018). Numerous species are recognised for their economic value as ornamentals, cut blossoms, and for culinary and beverage applications (Tiawoun et al., 2024).

Parthenium is an annual herb that aggressively colonises disturbed locations. According to the IUCN, it is classified as one of the "100 most invasive species in the world." It impacts human and animal health, the production of commodities, and biodiversity. The efficacy of its invasion is also significantly influenced by the genetic diversity present in various populations and biotypes (Tiawoun et al., 2024).

Parthenin, hysterin, hymenin, and ambrosin are significant compounds that are present in Parthenium plants. It is notorious for its potential environmental, medicinal, and agricultural hazards. (Khan et al., 2022). When parthenin damages the crops, virtually all spores are scattered. However, these parthenin are rinsed and transported away by rainfall and floods to large water bodies such as rivers and reservoirs, where they modify the physico-chemical properties of FW mussels, even when present in restricted areas. This work looks to probe the case study on the parthenium induced stress in FW mussels.

## Case presentation

In the present case study, bivalve growth is influenced by their health and metabolism, which can be altered by stress, such as handling exposure to chemical or plant stressors. Growth rate changes are gradual; this metric would not enable the rapid detection of pollution, but it may be beneficial for the monitoring of water quality in a more general context during long-term environmental change, on a scale of months or even years. Suboptimal water quality is expected to result in the lowest growth rates. It is important to acknowledge that growth may not always decrease in response to a rise in contaminants. For example, the FW mussel exhibits a positive correlation with growth when exposed to certain contaminants, such as lead and cadmium. Additionally, metals can alter the chemical configuration of shell material, resulting in deformation along with blistering.

The research presented in this case study is broadly divided into four sections: a. The biochem. parameters, analysis of enzyme activity and analysis of histological evaluation.

### 1. Analysis of Biochemical parameters

#### a. Glycogen

A substantial decrease in glycogen content was observed in nearly all tissues, including the foot, gills, and mantle, among the bivalves *Lamellidens corrianus*, following treatment with LC50/2 of 96 hours of Parthenin (0.89 ppm).

#### b. Proteins

The total PC of the bivalves *Lamellidens corrianus* was significantly reduced ( $P < 0.01$ ) in most tissues, including the foot, gills, and mantle, when treated with LC50/2 of 96 hours of Parthenin (0.89 ppm) in comparison to the control group

### c. Lipids

When bivalves *Lamellidens corrianus* were treated with a 96-hour LC50/2 of parthenin (0.89 ppm), the total lipid content in most tissues—the foot, gills, and mantle—was much lower than in the control group

## 2. Analysis of enzyme activity

### a. Lactate Dehydrogenase

Lactate Dehydrogenase content inside the gills along with digestive organ of *Lamellidens corrianus* bivalves was significantly elevated in comparison to the control group after treatment with LC50/2 of 96 hours of Parthenin (0.89 ppm) (0.39 ppm). LDH content in the gills increased significantly ( $P < 0.05$ ) after 24 hours of exposure to Parthenin.

### b. Alkaline Phosphatase

In comparison to the control group of bivalves, a substantial increase in alkaline Pase content was observed inside the gills along with digestive glands of *Lamellidens corrianus* after treatment with LC50/2 of 96 hours of Parthenin (0.89 ppm) (0.39 ppm). At 96 hours of exposure to both insecticides, a substantial increase ( $P < 0.05$ ) in ALP was seen in the gills and digestive tract.

### c. Acid Phosphatase

Acid Pase content inside the gills along with digestive organ of *Lamellidens corrianus* bivalves was significantly elevated in comparison to the control group after treatment with LC50/2 of 96 hours of Parthenin (0.89 ppm) (Table 4.16). Gills exhibited a substantial increase ( $P < 0.05$ ) during exposure for 24 and 72 hours.

## 3. Analysis of Histological evaluation

Parthenin exposure resulted in bivalve gill injury. The cellular structure of the epithelial and CT cells has been lost. The epithelium and CT were necrotic, edemic, and vacuolated. Epithelial cells, cilia, and the chitinous rod of the gill filament were observed to be deranged. In contrast to the control group, secondary lamellae fused and the distance between water channels and interlamellar junctions was diminished.

The histological architecture of the digestive gland demonstrated an increase in the size of the lumen of the digestive tubules, an increase in the number of spaces in the inter-tubular CTs, and a derangement of the basement membrane. Additionally, some tubules were ruptured, and epithelial cells were deranged in comparison to the control.

Beyond valve movements, alternative behavioural metrics have received relatively little attention, particularly during the development phase. Additionally, tracking multiple behaviours and their related attributes, or observing several species at once, can yield deeper insights, creating systems that are both more informative and more sensitive. This section will investigate these potential areas for system improvement.

Also, emerging technologies will be emphasised, which have the potential to enhance and revolutionise both conventional and alternative behavioural metrics. Additionally, the majority of monitoring systems fail to adequately account for the variability in pollutant responses within a species. This can result in the incorrect adjustment of system sensitivity to lvl.s that are either too high (resulting in false alarms) or too low (resulting in missed pollution discharges). We will offer recommendations on how to address this challenge in order to enhance the current bivalve-grounded methodologies.

## Discussion

Water pollution is a significant global issue, as it causes the onset of a variety of fatal diseases, which are responsible for the deaths of more than 14,000 individuals each day. There are numerous causes and characteristics of water pollution. The presence of toxins in water can alter its character, rendering it potentially detrimental to these life forms rather than sustaining them (Kankam, 2021).

Bivalve growth is influenced by their health and metabolism, which can be altered by stress, such as handling, ambient physical factors, such as temperature (Zhang et al., 2019), or exposure to chemical stressors (Mincy & McKinney, 2019). Physical or laboratory examinations, such as sclerochronology, which involves the investigation of shell growth rings (Lundquist et al., 2019), or scope for growth, which involves the measurement of the energy available for growth through various physiological responses, are frequently employed to study changes in growth.

In order to prevent detrimental effects, the sensory system of an organism may be able to identify toxicants in the environment, even at low conc.s. Motile organisms can safeguard themselves by evacuating the polluted location. However, sedentary organisms, such as gastropods and bivalves, may mitigate deleterious effects by generating mucus, which reduces the exposure of the external body surface, or by enclosing the body in the shell or closing syphons. The shell closing mechanism may serve as a protective mechanism against the toxicant and promotes high tolerance in molluscs (Goswami and Bhalla, 2021). *Lamellidens consobrinus* was observed to secrete mucus in response to heavy metal exposure (Wato et al., 2020).

In the current study, bivalves treated with parthenin exhibited a greater amount of mucus secretion, which was consistent with the findings of previous researchers (Kumar et al., 2017).

The toxicity of parthenin on histological evaluation in bivalve *Lamellidens corrianus* was investigated. Shinde et al. (2019) reported that the rate of oxygen consumption in the FW lamellibranch mollusc *Lamellidens corrianus* varied substantially in the LC10 and LC50 groups as a result of pesticidal stress caused by Thiodan (Endosulfan 35 % EC). The rate was significantly reduced. It can be claimed that the gill architecture and the rate of oxygen consumption may have been influenced by the penetration of pesticides into the body of bivalves. Furthermore, it is asserted that *Lamellidens corrianus* failed to adapt to the ongoing pesticidal stress by adopting a new state of metabolism as a result of pesticidal toxicity. The metabolic activity of the aquatic organism is altered as a result of the stress caused by parthenin. The physiological state of metabolic activity of an organism and the alteration in biochem. composition of tissues as a result of heavy metals and pesticides are indicative of the effective utilisation of biochem. energy to respond to toxic stress. The biochem. changes in bivalves that are observed and represent an adaptive or regulatory mechanism may be the result of a pathological effect. The most fundamental approach to examining the physiological changes that occur following pesticide and heavy metal treatment is to examine the changes in biochem. constituents. Carbohydrates, proteins, and lipids are critical metabolites that supply energy to a variety of essential processes (Shinde et al., 2021).

Gill glycogen lvs were found to be depleted in copper-exposed mussels at all time periods in all exposures when compared to the controls. However, depletion was more pronounced in mussels exposed to mercury at later periods of exposure. A greater reduction in glycogen lvs was observed in mussels that were exposed to cadmium at the greatest conc.. It is suggested that the anaerobic

conditions that were present in mussels that were exposed to heavy metals may have led to an increased degradation of glycogen. The toxic effect of thiodan resulted in a depletion of glycogen lvls in the FW bivalve *Lamellidens corrianus*. Consequently, the degradation and potential utilisation of protein in tissues such as the gills, foot, and mantle may have contributed to their depletion. A decrease in tissue protein is a sign of decreased protein synthesis, low assimilation of food, and low amino acid absorption for PS. Organophosphates are recognised for their direct methylation and phosphorylation of cellular proteins (Goswami and Bhalla, 2021).

The drop in PC in various tissues following chronic exposure to pesticides, as stated by Goswami and Bhalla (2021), suggests that pesticides inhibit PS, which ultimately leads to an increase in the free amino acid pool in the cell. However, PS can be inhibited during periods of elevated pollution stress, suggesting that the body's typical metabolic processes are disrupted. The digestive glands were the most significantly impacted organ, followed by the gill, whole body, mantle, gonads, and foot, as evidenced by the total PCs in all tissues. The digestive gland's increased protein depletion may be attributed to its superior metabolic efficiency and potency in comparison to other tissues, including the mantle, foot, gills, gonads, and entire soft body of the bivalve. In the body of bivalves, the digestive gland is the primary site of pesticide degradation and detoxification. Consequently, it has the highest energy demand for metabolic processes, which leads to an increased utilisation of protein in the digestive gland. This provides a more accurate indication of the extent of toxicity. The most significant alteration of PCs in the digestive organs of FW bivalves was advocated by Goswami and Bhalla (2021). The digestive organs experience the greatest protein depletion compared to the mantle, gills, foot, and entire body tissue.

## Conclusion

Bivalves are susceptible to a variety of aquatic pollutants, as evidenced by the measurement of the behavioural metrics identified in this study. By integrating various metrics, it is possible to acquire more detailed information regarding the behavioural responses of bivalve organisms, . Chemical stressors like parthenin, which impede activity and affect health, are likely to influence horizontal movement and burial, as they do with other behaviours. The protein, glycogen content has been lowered in FW mussels. Additionally, some tubules of FW mussels were ruptured, and epithelial cells were deranged in comparison to the control.

This implies that the detection of pollutants at their lowest conc.s can be particularly facilitated by the finer details in behavioural changes (e.g. heart rate variability), whereas the detection of higher parthenin conc.s is more effective with alterations on an increasingly larger scale (e.g. heart rate or valve position). This is in accordance with the results of a comparison of the attributes of measured valve movement. These differential effects should offer insight into the severity (conc./toxicity) of a contamination episode.

## References

1. Baruah, V.J., Wani, S.M., Hussain, A., Saluja, M. and Sarmah, B., 2024. 11 Recent Advances in Nanotechnology-Based Crop Management. *Sustainable Green Nanotechnology: Food and Agriculture Paradigm*, p.187.
2. Kumar, N. and Aggarwal, N.K., 2024. A review on valorization, management, and applications of the hazardous weed *Parthenium hysterophorus*. *Systems Microbiology and Biomanufacturing*, 4(2), pp.607-619.
3. Dias, R., D'Costa, A., Praveen Kumar, M.K. and Shyama, S.K., 2021. DNA damage and biochemical responses in estuarine bivalve *Donax incarnatus* (Gmelin, 1791) exposed to

- sub-lethal concentrations of an organophosphate pesticide monocrotophos. *Environmental Monitoring and Assessment*, 193(6), p.317.
4. Sharma, A., Kumar, V., Shahzad, B., Tanveer, M., Sidhu, G.P.S., Handa, N., Kohli, S.K., Yadav, P., Bali, A.S., Parihar, R.D. and Dar, O.I., 2019. Worldwide pesticide usage and its impacts on ecosystem. *SN Applied Sciences*, 1, pp.1-16.
  5. KANKAM, F., 2021. Causes and management of pesticides contamination in agriculture: A review. *Ghana Journal of Science, Technology and Development*, 7(2), pp.103-118.
  6. Balamurugan, S. and Chakravarthy, B.D., 2024. Evidence of Seasonal Variations in the Biochemical Composition of Subcellular Fractions in Tissues of the Freshwater Mussel *Lamellidens marginalis*. *TWIST*, 19(1), pp.246-255.
  7. Ahmed, A. and Rahman, M.S., 2024. Histological, biochemical and immunohistochemical assessments of Roundup®, atrazine, and 2, 4-D mixtures on tissue architecture, body fluid conditions, nitrotyrosine protein and Na<sup>+</sup>/K<sup>+</sup>-ATPase expressions in the American oyster, *Crassostrea virginica*. *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology*, 283, p.109951.
  8. Mincy, G. A. and McKinney M. L., 2019. The Asian clam *Corbicula fluminea* as a pollution sentinel species. *Journal of Shellfish Research* 38, p.183–190.
  9. Zhang, P., T. Zhao, L. Zhou, G. Han, Y. Shen and Ke C., 2019. Thermal tolerance traits of the undulated surf clam *Paphia undulata* based on heart rate and physiological energetics. *Aquaculture* 498, p.343–350.
  10. Lundquist, S. P., Worthington T. A. and Aldridge D. C., 2019. Freshwater mussels as a tool for reconstructing climate history. *Ecological Indicators* 101, p.11–21.
  11. Wato, T., Amare, M., Bonga, E., Demand, B.B.O. and Coalition, B.B.R., 2020. The agricultural water pollution and its minimization strategies—A review. *J. Resour. Dev. Manag*, 64, pp.10-22.
  12. Goswami, D.B. and Bhalla, R., 2021. Ameliorating effect of L-Ascorbate on protein and ascorbic acid content in different tissues of freshwater bivalve *Lamellidens marginallis* on exposure to lambda-cyhalothrin. *Environment Conservation Journal*, 22(1&2), pp.159-166.
  13. Kumar, N., Krishnani, K.K. and Singh, N.P., 2017. Oxidative and cellular stress as bioindicators for metal contamination in freshwater mollusk *Lamellidens marginalis*. *Environmental Science and Pollution Research*, 24, pp.16137-16147.
  14. Shinde, N.G., Gaikwad, D.M. and Vedpathak, A.N., 2019. Effect of Ablation of Cerebral Ganglia and Injection of Their Extracts on Rate of Oxygen Consumption of Freshwater Bivalve: *Lamellidens Corrianus* (Lea) During Different Seasons. *International Journal of Research and Analytical*, p.51.



EARN YOUR

# MBA

WWW.IIMPS.IN



Accreditation & Ranking



UGC / NCTE Approved.

INFO@IIMPS.IN

☎ 011-41005174

RESEARCH  
GATEWAY

## STOP PLAGIARISM



**Arogyam Ayurveda**  
Holistic Healing through herbs



AROGYAM  
ONLINE

## PARIVARTAN PSYCHOLOGY CENTER

परिवर्तन

### COLOR PSYCHOLOGY : HOW COLOR AFFECT YOUR CHILD



BLUE

Calms your Child's  
Mind & Body

YELLOW

Promotes Concentration,  
Stimulates the Memory

PINK

Evokes Empathy,  
makes your Child Calm

RED

Excites and energizes  
your Child's body

GREEN

Improves Reading speed  
and Comprehension

www.parivartan4u.com



परिवर्तन

Confuse about your children's future?

**भारतीय भाषा, शिक्षा, साहित्य एवं शोध**

ISSN 2321 – 9726

[WWW.BHARTIYASHODH.COM](http://WWW.BHARTIYASHODH.COM)



**INTERNATIONAL RESEARCH JOURNAL OF  
MANAGEMENT SCIENCE & TECHNOLOGY**

ISSN – 2250 – 1959 (O) 2348 – 9367 (P)

[WWW.IRJMSST.COM](http://WWW.IRJMSST.COM)



**INTERNATIONAL RESEARCH JOURNAL OF  
COMMERCE, ARTS AND SCIENCE**

ISSN 2319 – 9202

[WWW.CASIRJ.COM](http://WWW.CASIRJ.COM)



**INTERNATIONAL RESEARCH JOURNAL OF  
MANAGEMENT SOCIOLOGY & HUMANITIES**

ISSN 2277 – 9809 (O) 2348 - 9359 (P)

[WWW.IRJMSH.COM](http://WWW.IRJMSH.COM)



**INTERNATIONAL RESEARCH JOURNAL OF SCIENCE  
ENGINEERING AND TECHNOLOGY**

ISSN 2454-3195 (online)

[WWW.RJSET.COM](http://WWW.RJSET.COM)



**INTEGRATED RESEARCH JOURNAL OF  
MANAGEMENT, SCIENCE AND INNOVATION**

ISSN 2582-5445

[WWW.IRJMSI.COM](http://WWW.IRJMSI.COM)



**JOURNAL OF LEGAL STUDIES, POLITICS  
AND ECONOMICS RESEARCH**

[WWW.JLPER.COM](http://WWW.JLPER.COM)

**JLPE**