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Curriculum Innovations in Aquaculture [DiBluCa]"
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Module 2:
Global warming and breeding, biotechnology in aquaculture

Presented by ONUT

Module Description and Relevance

- This module explores the interplay between global warming and aquaculture biotechnology. It emphasizes the transformative potential of genetic engineering, selective breeding, and advanced technologies to mitigate environmental challenges and sustain aquatic biodiversity.

Main Argument of the Module

- The integration of biotechnology into aquaculture is essential for addressing the dual challenges of climate change and sustainable food production. By leveraging genetic advancements and responsible innovation, the industry can ensure resilience, productivity, and ecological balance.

Introduction

- Aquatic ecosystems face unprecedented challenges due to global warming. This module delves into how biotechnology transforms aquaculture to address these challenges while ensuring sustainability and biodiversity conservation.

  - Relevance:
  - – Addresses food security and biodiversity conservation
  - – Equips students with knowledge and tools to innovate responsibly

Global Warming and Aquatic Ecosystems

- - Rising temperatures disrupt breeding cycles and metabolic rates.
- - Altered spawning times lead to food resource mismatches.
- - Reduced oxygen levels and increased stress on larvae.
- - Limited genetic adaptation to rapid environmental changes.

Biotechnological Solutions in Aquaculture

- - **Selective Breeding**: Enhancing resilience to temperature and diseases.
- - **Genomic Selection**: Accelerating identification of beneficial traits.
- - **CRISPR/Cas9**: Precision gene editing for growth, muscle quality, and disease resistance

Case Studies in Biotechnology

- - Examples:
- Selective Breeding in Atlantic Salmon: Improved heat tolerance
- CRISPR in Nile Tilapia: Enhanced growth and disease resistance
- Genomic Selection in Rainbow Trout: Traits linked to resilience identified and propagated
- Cryopreservation supporting biodiversity and breeding efficiency.

Cryopreservation in Aquaculture

- Applications:
- - Long-term preservation of genetic resources
- - Breeding efficiency and biodiversity conservation
- Challenges:
- - Toxicity of cryoprotective agents
- - Complexities in oocyte and embryo cryopreservation

Ethical and Regulatory Perspectives

- - **Animal Welfare**: Addressing stress and genetic risks.
- - **Ecological Integrity**: Preventing genetic pollution.
- - **Regulation**: Global and national frameworks for sustainable practices.

Conclusion

- The future of aquaculture lies in responsibly integrating biotechnology to address global challenges. By fostering sustainability, innovation, and ethical practices, students can become leaders in advancing aquaculture and biodiversity conservation.

Call to Action:
- Engage in interdisciplinary research
- Advocate for responsible innovation in aquaculture

References

- - Angilletta et al. (2004), Chevin et al. (2010), Jorgensen et al. (2017)
- - Zhu et al. (2024), Fletcher & Rise (2012), Sankaran & Mandal (2024)

Key Questions Addressed by the Module

- - How does global warming affect aquatic species?
- - What are the cutting-edge biotechnological solutions in aquaculture?
- - How can sustainability and innovation be balanced in biotechnology?
- - What ethical and regulatory considerations arise in aquaculture biotechnology?

Learning Outcomes

1. Knowledge:

- Define key concepts related to global warming impacts on aquaculture.
- List biotechnological methods such as selective breeding, genomic selection, and CRISPR/Cas9 in aquaculture.

2. Comprehension:

- Explain how rising temperatures influence the breeding cycles and genetic adaptations of aquatic species.
- Describe the mechanisms of biotechnological tools and their applications in aquaculture.

3. Application:

- Apply knowledge of genomic selection to propose solutions for enhancing heat tolerance in specific fish species.

4. Analysis:

- Analyze the relationship between environmental changes and the productivity of aquaculture species.
- Evaluate the advantages and ethical concerns of using CRISPR/Cas9 technology.

5. Synthesis:

- Design a biotechnological intervention plan to improve the sustainability of an aquaculture operation.
- Develop a proposal for addressing biodiversity loss through genetic conservation strategies

6. Evaluation:

- Assess the effectiveness of biotechnological solutions in mitigating the impacts of climate change on aquaculture.
- Critically evaluate the ethical, environmental, and regulatory considerations surrounding the use of genetic modifications in aquaculture systems.

Q&A