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Tackling antimicrobial overuse in aquaculture with the MALDI Biotyper®

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Aquaculture, a booming source of animal protein, is challenged by the increasing use of antimicrobials, contributing to the rise of antibiotic-resistant bacteria. This significantly impacts global health, also due to the widespread environmental distribution of these drugs in the water. MALDI-TOF MS provides an accurate, rapid and cost-effective solution for quickly detecting pathogens and specific antibiotic resistance markers. Implementing this technology can foster sustainable aquaculture practices and improve food safety.

One of today's major global health challenges is the rise of antibiotic-resistant bacterial strains. A significant cause of this issue is the increasing use of antimicrobials in humans and, notably, in animals intended for food production.[1] While recently increasing awareness and regulations have addressed antibiotic use in terrestrial animal meat production, the same cannot yet be said for aquaculture.[2] Aquaculture, is a vital and rapidly expanding source of animal protein, especially in low- and middle-income countries. The latest data suggest that the growth rates seen for global fish consumption as food surpass that of terrestrial animal meats combined, except the one for poultry.[3]

As with the rising demand for meat decades ago, the growing global demand for fish is being met through more optimized production processes, aiming for the maximum yield.[4] This optimization predictably increases the incidence and spread of aquatic pathogens, necessitating

an elevated use of antimicrobials, often non-therapeutically, but rather to promote growth.[5] Unfortunately these practices are contributing to the rise of antimicrobial-resistant bacteria. Unlike terrestrial animal production, antimicrobial use in aquaculture poses a greater risk, distributing drugs more broadly through the water, significantly impacting surrounding ecosystems and human health.[2] Numerous studies have confirmed the close link between environmental antimicrobial resistance and the resistance of human pathogens.[6]

Establishing good farming practices to avoid the preventive use of antibiotics and monitoring aquatic animal diseases through surveillance and rapid bacterial detection methods is essential. This allows for timely interventions and management of diseases before they become serious threats. Therefore, accurate, rapid and cost-effective identification techniques are crucial to tackle this task.

Traditionally, aquatic pathogens have been identified using microbiological, biochemical, immunological or molecular approaches. These methods required isolating and culturing of bacteria, followed by morphological observation and further characterization. Various kits, reagents and instruments have been necessary in the past to classify unknown bacterial isolates. Serological, histopathological, and immunoenzymatic tests (ELISA) have also been vital in diagnosing bacterial diseases. Since the 1990s, molecular methods like PCR and Sanger sequencing have been used to identify bacterial diseases in fish, and although next-generation sequencing (NGS) has improved diagnosis, it remains costly and time-consuming.[7]

In recent years, MALDI-TOF MS has emerged as a rapid, accurate, and cost-effective technology for the identification of aquatic pathogens. Reports from 2010 to 2023 highlight its effectiveness and efficiency in identifying bacterial pathogens in aquaculture.[7] It is not only a cutting-edge technology for rapid and accurate microbial identification but also allows for the quick detection of the presence of specific antibiotic resistance markers. This aids in early disease diagnosis and implementing timely and effective intervention strategies, promoting sustainable aquaculture practices and healthier farming.

The MALDI Biotyper represents an advanced solution for microbial identification in food safety and related applications, offering a rapid, robust, and cost-effective method for identifying bacteria, and specific resistance markers.

References

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