Lessons Learned and Future Approaches in Antimicrobial use in Aquaculture – Experiences with Streptococcosis in Southern Africa

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Multifactorial causes of fish disease

Trout / Tilapia

Climate, water quality, feed, husbandry, trauma, farm design

Streptococcus

Antimicrobials

host

pathogen

disease

environment
Healthy gill microvasculature

Vortex formation feeding into a pipe – one of many causes of gas supersaturation
Gas emboli in gill – obstruct gill microvasculature
High pH - inability to excrete ammonia - autointoxication – hyperplasia of gill epithelium - increased oxygen diffusion pathway – fish unable to extract sufficient oxygen from water
Intensive fish farming

• Large amount of organic waste favours growth of environmental bacteria
• High population density creates a suitable host population for opportunistic bacteria from the environment
• Sub-optimal environmental conditions provide a weakened host - selection pressure benefits more virulent opportunistic bacteria
• Repeated antibiotic use - selection pressure favours antibiotic resistant bacteria
Disease management

- Identify risk factors
- Limit losses – short term gain by using antimicrobials
- Optimize production
- Optimize husbandry
- Consumer concerns – antimicrobial residues
- Environmental concerns – development of antimicrobial resistance
With injudicious repeated use of antimicrobials

- Antimicrobial sensitivity declines in the pool of bacteria associated with the farmed environment
- Increasingly virulent strains of bacteria emerge
- Virulent fish-associated bacteria are moved with transport of live fish and threaten other producers
Gram positive, coccus shaped, non-haemolytic bacteria

- *Lactococcus garviae / Enterococcus seriolicida*
- *Streptococcus iniae*
- *Streptococcus parauberis*
- *Carnobacterium piscium*
- *Streptococcus D*
- Other *Streptococcus* species
Streptococcal infection of trout

- Disease peculiar to South Africa
- First described from rainbow trout in 1974
- Important septicaemic summer disease
- Primarily an environmental disease related to stress factors
- Treatment with oxytetracycline resulted in suppression of disease but not in cure
- Emergence of resistance to oxytetracycline
Bacterial septicaemia
Streptococcus infection
Streptococcus septicaemia in trout – precipitating environmental factors

- Low water flow and high water temperature
- High daytime water pH due to algal photosynthesis
- Ammonia build up in water and gills
- Low DO
- High dissolved gas pressure
- Build up of infective dose
During the early years of intensive trout farming in South Africa

• Bacterial isolates showed good sensitivity to a number of readily available antibiotics
• Antibiotics were repeatedly used during the summer months to control outbreaks of streptococcal disease
• Antibiotic use at best controlled losses from streptococcal infection but seldom achieved a sustainable cure
• **Oxytetracycline** was mainly used for cost and availability reasons.
More recently

- **Oxytetracycline** found to be no longer efficacious
- Most isolates still sensitive to **amoxycillin**.
- Fish responded well to amoxycillin with better cure rates than those achieved with **oxytetracycline**
- Already some *Streptococcus* isolates identified showing resistance to **amoxycillin**
- **Erythromycin** used elsewhere in the world but not in South Africa. Florfenicolic not available as registered in feed medication for fish in South Africa
- Use of **autogenous vaccines** against streptococcosis is becoming more accepted with generally good results
Streptococcus infection in Nile tilapia in Southern Africa

- *Streptococcus iniae*
- *Lactococcus garviae*
- *Streptococcus parauberis*
Stocking density – trauma - cage size
Typical lesions seen with *Streptococcus* infection in tilapia
Inbalanced feeds – ascorbic acid and omega 3 fatty acids
Dissolved oxygen levels
Stocking density
Feeding practices
Lax enforcement of legislative controls will promote the injudicious use of antimicrobials to the detriment of

- the consumer
- the environment
- sustainable aquaculture
Sourcing of antimicrobials

- According to antimicrobial sensitivity of isolates from disease outbreak
- Antimicrobial registered for use in aquatic animals for human consumption – none in South Africa
- Off-label use on veterinary prescription
- The script may be from the aquatic veterinarian involved with the disease outbreak or from a generalist veterinarian supplying bulk scripts
- Availability and cost of the drug influences choice.
- Often raw active drug intended for manufacture of human and veterinary drugs is sourced
Use of antimicrobials in South Africa - legal / illegal

- Most antimicrobials are supplied by an aquatic veterinarian or under veterinary prescription for the first time

- The responsible veterinarian loses control of antimicrobial use when:
  - Farmers look for cheaper suppliers – often directly from wholesalers or importers or from other sectors of the livestock industry.
  - Antimicrobials supplied without script or on blanket script from a veterinarian not involved with fish.
Who decides when to treat? Farmer or veterinarian

- Aquatic veterinarian may supply antibiotic to see fish through a crisis while underlying causes are addressed
- Farmer may be unwilling or unable to make recommended changes and rather sources further antibiotic without veterinarian’s knowledge to safeguard his investment
- Repeated injudicious use by the farmer leads to selection of antimicrobial resistant strains predominating on the farm
Do antimicrobials have a place in modern aquaculture?
Intensive farming creates environments conducive to emergence of bacterial pathogens.
Future of antibiotic use

• If used judiciously, antibiotics will continue to play a crucial role in seeing fish through times of unanticipated environmental conditions.
• Antibiotics should not be used to bridge nutritional and husbandry shortcomings that can be solved in more appropriate ways.
• Where possible vaccination should be used to control bacterial disease.
Farmers can curtail emergence of bacterial pathogens by:
1. Identifying and understanding underlying causes
2. Following good bio-security practices

but NOT by reliance on antibiotics