Aquaculture Overview

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Feb. 27, 2020
PACCARB
Aquaculture

- Aquaculture is the fastest growing food production sector globally and now provides ½ of all fish consumed by humans.
- Global fish production in 2016 reached an all time high of 171 million tons:
  - 88% direct human consumption
  - Aquaculture – 80 million tons
- Value of fisheries and aquaculture estimated at $362 billion:
  - $232 billion estimated from aquaculture
- Globally, per capita food fish consumption grew from 9 kg in 1961 to 20.2 kg in 2015 and is growing.
Aquaculture

- Aquatic products for direct and indirect human consumption have two origins
  - Capture fisheries and aquaculture
- Capture fisheries refers to the catching, processing and marketing of wild fish/shellfish
- Aquaculture is the purposeful breeding, rearing, and harvesting of fish, shellfish, algae and other organisms in all types of water environments
  - 2 main types
    - Marine – net pens in the water or tanks on land
    - Freshwater – ponds or other manmade systems
Aquaculture Production of Fish, Crustaceans and Mollusks, 2016

<table>
<thead>
<tr>
<th>Country</th>
<th>Volume (metric tons)</th>
<th>Value (1000 US$)</th>
<th>Continent</th>
<th>Volume (metric tons)</th>
<th>Value (1000 US$)</th>
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</thead>
<tbody>
<tr>
<td>China</td>
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<td>144,701,650</td>
<td>Asia</td>
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<td>10,844,801</td>
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<td>1,992,111</td>
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<td>Philippines</td>
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<td>1,760,726</td>
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<td>676,766</td>
<td>3,842,331</td>
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<td>Brazil</td>
<td>580,500</td>
<td>1,211,037</td>
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<td>South Korea</td>
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<td>United States of America</td>
<td>444,369</td>
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<td>All others</td>
<td>5,138,336</td>
<td>18,385,715</td>
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<tr>
<td><strong>Total</strong></td>
<td><strong>80,030,882</strong></td>
<td><strong>231,584,132</strong></td>
<td></td>
<td><strong>80,030,882</strong></td>
<td><strong>231,584,132</strong></td>
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</tbody>
</table>

Source: FAO, U.S. total may not agree with other estimates in this section.
Additional details on global aquaculture production can be found in the world section.

- Asia produces 89% of the global aquaculture production of fish, crustaceans and mollusks
  - Top 5 producing countries are China, India, Indonesia, Vietnam and Bangladesh
  - U.S. ranks 16th
- U.S. is the leading global importer of fish and fishery products
  - Nearly 90% of the seafood we eat comes from abroad
  - Over ½ from aquaculture

U.S. Data

- Estimated freshwater plus marine U.S. aquaculture production was 633 million pounds with a value of $1.5 billion.
- Freshwater production is primarily catfish, crawfish and trout.
- Top U.S. marine aquaculture species were:
  - Oysters ($192 million)
  - Clams ($138 million)
  - Atlantic salmon ($68 million)
- U.S. per capita consumption was 16 pounds.
- U.S. consumers spent an estimated $102.2 billion.
Aquaculture Techniques

- Hatcheries - mix of a laboratory and farm, where fish and shellfish are spawned, hatched and cared for
- Pond culture - one or many earthen ponds are used to culture some freshwater species
- Cage culture - enclosed cages are submerged in aquatic environments
  - Careful protocols and monitoring help to minimize potential interactions with the environment
- Recirculating systems - fish, shellfish, and or plant-life are raised in "closed-loop" production systems that continuously filter and recycle water and waste
- Integrated Multi-Trophic Aquaculture - several species are raised together in a way that allows one species' by-products to be recycled as feed for another

https://www.fisheries.noaa.gov/insight/understanding-marine-aquaculture
Disease and Health Management Challenges

- Aquaculture, like any other type of farming has effects on surrounding ecosystems

- Significant issue is maintaining animal health and controlling disease
  - FAO estimates 40% losses due to disease

- Numerous bacterial, mycotic, viral and parasitic diseases of aquatic species
  - Bacterial pathogens include *Aeromonas, Pseudomonas, Vibrio, Photobacterium, Edwardsiella, Flavobacterium, Streptococcus* and *Mycobacterium* species

- Due to nature of dense populations, increased reliance on antimicrobials to control disease

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### PRINCIPLES FOR RESPONSIBLE AND PRUDENT USE OF ANTIMICROBIAL AGENTS IN AQUATIC ANIMALS

**Article 6.2.1.**

**Purpose**

These principles provide guidance for the responsible and prudent use of antimicrobial agents in aquatic animals, with the aim of protecting both animal and human health. The Competent Authorities responsible for the registration and marketing authorisation of products and the control of all organizations involved in the production, distribution and use of antimicrobial agents have specific obligations.

**Article 6.2.2.**

**Objectives of responsible and prudent use**

Responsible and prudent use includes a set of practical measures and recommendations intended to reduce the risk associated with the selection and documentation of antimicrobial-resistant microorganisms and antimicrobial resistance determinants in aquatic animal production to:

1. maintain the efficacy of antimicrobial agents both for veterinary and human medicine and to ensure the rational use of antimicrobials in aquatic animals with the purpose of optimising both their efficacy and safety;
2. comply with the ethical obligations and economic need to keep aquatic animals in good health;
3. prevent or reduce the transfer of resistant microorganisms and resistance determinants from aquatic animals to human and terrestrial animals;
4. prevent antimicrobial residues that exceed the established maximum residue limit (MRL) occurring in the food.

**Definition**

Pharmacovigilance of antimicrobial agents: means the detection and investigation of the effects of the use of these products, mainly aimed at safety and efficacy in aquatic animals and safety in people exposed to the products.

**Article 6.2.3.**

**Responsibilities of Competent Authorities**

The Competent Authorities responsible for granting marketing authorisation for antimicrobial agents have a significant role in specifying the terms of the authorisation and in providing the appropriate information to the consumer or other relevant persons in the health profession through product labelling and/or other means, in support of prudent use of antimicrobial agents in aquatic animals.

It is the responsibility of Competent Authorities to develop up-to-date guidelines on data requirements for evaluation of antimicrobial agent applications.

Competent Authorities in cooperation with animal and public health professionals should adopt a proactive approach to monitor prudent use of antimicrobial agents in aquatic animals as an element of a comprehensive strategy for the containment of antimicrobial resistance.

Elements of a comprehensive strategy should include good animal husbandry practices, vaccination policies and development of animal health care at the farm level, and consultation with a veterinarian or other aquatic animal health professional.
Aquatic Animal Diseases listed by the OIE

- OIE criteria include potential international spread of the pathogenic agent is likely
- At least one country demonstrates freedom from the disease in susceptible aquatic animals
- A reliable means of detection and diagnosis exists
- And
  - Natural transmission to humans has been proven or;
  - Disease shown to affect the health of cultured aquatic animals or;
  - Disease shown to affect the health of wild populations resulting in significant morbidity or mortality

The following diseases of crustaceans are listed by the OIE:
- Acute hepatopancreatic necrosis disease
- Infection with Aphanomyces astaci (crayfish plague)
- Infection with Helicobacter pylori (necrotising hepatopancreatitis)
- Infection with infectious hypodermal and hematopoietic necrosis virus
- Infection with infectious myonecrosis virus
- Infection with Macrobrachium rosenbergii nodavirus (white tail disease)
- Infection with Taura syndrome virus
- Infection with white spot syndrome virus
- Infection with yellow head virus genotype 1.

The following diseases of fish are listed by the OIE:
- Infection with Aphanomyces astaci (crayfish plague)
- Infection with epizootic haematopoietic necrosis virus
- Infection with Gyrodactylus salaris
- Infection with HPR-infected or HPR8-infected salmon anemia virus
- Infection with infectious haematopoietic necrosis virus
- Infection with koi herpesvirus
- Infection with red sea bream lodo virus
- Infection with salmonid alphavirus
- Infection with spring viraemia of carp virus
- Infection with viral haemorrhagic septicaemia virus

The following diseases of molluscs are listed by the OIE:
- Infection with abalone herpesvirus
- Infection with Bovine ostreae
- Infection with Boeckia ostreae
- Infection with Marteilia refringens
- Infection with Perkinsus marinus
- Infection with Perkinsus obtusa
- Infection with Xylophilus californiensis.
U.S. Approved Aquaculture Antibiotics

<table>
<thead>
<tr>
<th>Active Ingredient</th>
<th>Trade Name</th>
<th>Generic Use</th>
<th>Application Method</th>
<th>Approval Status</th>
<th>Withdrawal Time</th>
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<tbody>
<tr>
<td>Florfenicol</td>
<td>Aquaflor®</td>
<td>Antibiotic</td>
<td>Medicated feed</td>
<td>FDA approved²</td>
<td>15 days</td>
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<td></td>
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<td></td>
<td>(Veterinary Feed Directive)</td>
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<tr>
<td>Oxytetracycline dihydrate</td>
<td>Terramycin-200®</td>
<td>Antibiotic</td>
<td>Medicated feed</td>
<td>FDA approved</td>
<td>21 days</td>
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<tr>
<td>Ormetoprim sulfadimethoxine</td>
<td>Romet-30®</td>
<td>Antibiotic</td>
<td>Medicated feed</td>
<td>FDA approved</td>
<td>42 days in salmonids; 3 days in catfish</td>
</tr>
</tbody>
</table>

Florfenicol is an approved medicated feed for use against specific pathogens in enteric septicemia (Edwardsiella ictaluri) in channel catfish, coldwater disease (Flavobacterium psychrophilum) in salmonids, furunculosis (Aeromonas salmonicida) in freshwater-reared salmonids, streptococcal septicemia in freshwater-reared warmwater finfish, and columnaris disease (Flavobacterium columnare) in freshwater-reared finfish. It is marketed as a VFD product. The withdrawal time is 15 days.

Oxytetracycline dihydrate is an in-feed medication approved 1) to control mortality in freshwater-reared salmonids due to coldwater disease associated with F. psychrophilum, 2) to control mortality in freshwater-reared rainbow trout due to columnaris disease associated with F. columnare, and 3) to mark skeletal tissue in Pacific salmon. All approved uses require a 21-day withdrawal period for harvest-size food fish species.

Ormetoprim sulfadimethoxine is an in-feed treatment approved by the FDA to control furunculosis (A. salmonicida) in salmonids, for which a 42-day withdrawal period is required, and to control enteric septicemia of catfish (E. ictaluri) in channel catfish for which a 3-day withdrawal period is required.
Disease and Health Management Challenges

• As aquaculture continues to rapidly expand, the risk of significant disease outbreaks becomes a major concern globally

• Pressing need for investment in aquatic health and greater access to disease management tools
  - Pathogen and host species data
  - Surveillance data
  - Vaccines
  - Antimicrobials
    • Stewardship programs
  - Rapid diagnostics
  - Biosecurity measures

• Need for development of sustainable aquaculture guidelines