[Test] Fish are also farm animals

1 message

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FindingPheno

I've been thinking a lot about fish recently and this is what it turned into.

Fish are also farm animals

When you talk to someone about farm grown meat, they generally think first of sheep or cows. But fish can also be grown on farms – in what is known as aquaculture. Aquaculture farms can take many forms, from big tanks on land to nets or pens in the water, and can include fresh or salt water depending on what species is being farmed. The fast advance of aquaculture technology in recent decades has increased the numbers and diversity of farmed marine species, and today aquaculture accounts for half of all seafood consumed globally. This growth is expected to continue (predicted CAGR 5.8% for the next 5 years) largely due to increasing consumer preference for farmed seafood as it is viewed by many as a healthy and sustainable diet option.

Fish can be green

This reputation for sustainability is well earned. Eating fish or shellfish grown on a farm does not contribute to the ongoing decline in wild populations and sometimes the breeding systems used in these farms can even be used to restock depleted fisheries in the wild. Meanwhile, aquaculture has lower carbon emissions than other types of meat with, e.g., beef production producing ten times more CO2 than salmon farming. This is in large part because fish are very efficient in turning inputs such as protein in their feed into meat compared with warm-blooded farm animals.

For example, salmon has a feed conversion ratio (FCR) of 1.2, i.e. they require 1.2 kg of feed to create a 1 kg increase of bodyweight, compared with the FCR of 6-10 for beef cows. In addition, by-products from aquaculture production can be repurposed to other uses ("circular economy") further reducing the environmental footprint. For example, left over fish skin or other trimmings that would otherwise be discarded can instead be used as ingredients in pet food or even to create biogas for local buses.

Aquaculture has challenges

Despite these benefits, aquaculture is still a relatively new industry which has not yet solved all its problems. The biggest challenges come from the nature of aquaculture farms where large numbers of the same animals are grown close together (high-density monoculture). For fish such as salmon grown in open nets, pens or cages, there is no solid barrier to the surrounding water and faeces, uneaten food, and other chemicals can wash out of the pens, polluting the environment with excess nutrients. While this pollution can be avoided by using closed or recirculating systems, they is not possible for all fish species. One method for reducing these problems in open systems is integrated multi-trophic aquaculture (IMTA), where different species are grown in close proximity to reduce waste. For example, seaweed or shellfish are grown next to the fish pens where they can filter out excess nutrients and convert them to biomass, then using the seaweed or shellfish as ingredients in feed for the fish, thus recycling nutrients while reducing external pollution. However, IMTA systems are complex and the methods are still under development.

Another big problem with aquaculture, and especially farmed fish, is the spread of disease through the closely packed animals. These diseases can be caused by pathogenic bacteria (e.g. furunculosis caused by Aeromonas salmonicida), highly infectious viruses (e.g. Infectious Pancreatic Necrosis Virus or Infectious Salmon Anemia Virus), or parasites such as sea lice (Lepeophtheirus salmonis). Disease outbreaks cause major economic losses for aquaculture farmers, with industry-wide estimates as high as $6bn lost per year because of this problem. In addition, the disease may spread beyond the farm into local wild fish populations causing a biosecurity hazard. Treatment methods have traditionally focused on antibiotics or harsh chemicals, but these may stress the fish, induce antimicrobial resistance, and contaminate the environment. This has led to a shift in emphasis towards strategies to reduce or prevent the spread of infection.able this transition to more precise and sustainable farming practises.

The microbiome can help

A key strategy for reducing disease is to support the health and natural resistance of the fish with good farming practises. Fish have built in defence systems, including innate and adaptive immune responses to kill invaders and physiological features such as changes in skin thickness, mucus secretion or nutrient availability that make it more hostile towards parasites or pathogens. The gut and skin microbiomes play a role in supporting these defence systems, e.g. helping shape immune development or affecting skin mucus production to fight infection. However, these microbiomes are negatively affected by factors such as stress, poor nutrition, antibiotics, or infection which may, in turn, reduce resistance to disease. In the case of sea lice infestations, the microbes living on the lice themselves can also damage fish health, for example bringing pathogens that infect and weaken the fish making them more susceptible to lice infestation. Together these factors highlight the importance of understanding all parts of the host-microbiome-pathogen/parasite system when designing improved farming methods to reduce disease burden.

Another widely used method for reducing infection is fish vaccines. While most currently approved vaccines involve injecting each fish individually, several oral vaccines are under development or in use where the antigen is introduced to the water (often as part of the food) then eaten by the fish and absorbed via the gut to stimulate the desired immune protection. The effectiveness of oral vaccines are influenced by several factors including vaccine formulation, host immune system, and the gut microbiome. Different gut microbes can either stimulate or suppress the tolerance mechanisms which work to reduce immune stimulation to microbial antigens. Therefore, by changing the composition of the microbiome in the right way, it may be possible to induce a better and more specific immune response to an oral vaccine.

So next time someone mentions farming, think of fish. This is a rapidly growing area with some challenges to solve, yes, but also a lot of potential - especially once we fully unlock the power of the host-microbiome interactions in these fishy farm animals.

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