

Unit 11 - Stress and immune response

Introduction

Stress is defined as physical or chemical factors that cause bodily reactions that may contribute to disease and death. Stress is a condition in which an animal is unable to maintain a normal physiologic state because of various factors adversely affecting its well-being. Stress is caused by placing a fish in a situation which is beyond its normal level of tolerance.

Types of stressors

The different types of stressors are

Chemical stressors:

- Poor Water Quality
- Pollution
- Nitrogenous and other metabolic wastes
- Acidification

Biological stressors:

- Over crowding
- Stress by other species of fish
- Pathogenic Microorganisms
- Parasites

Physical stressors:

- Temperature
- Light
- Sounds
- Dissolved oxygen
- Ammonia

Procedural stressors:

- Handling
- Shipping
- Disease Treatments

Stress and immune system

Stress affects the immune system of fish as it affects in higher animals, the cause of stress is referred as stressor. The stress response in fish is controlled by HPI axis. This stands for Hypothalamus-Pituitary- inter-renal axis. That means that the brain, pituitary, and inter-renal tissue.

Stress stimulates a part of the brain called the hypothalamus. The hypothalamus releases a hormone called corticotrophin releasing factor, or CRF and this hormone stimulate the pituitary gland to release Adrenocorticotrophic hormone, or ACTH. ACTH intern stimulates the inter-renal tissue to release Two important hormones.

- Epinephrine
- Cortisol

Epinephrine

Epinephrine, is responsible for what is called the "fight or flight" reaction. This hormone produces a number of physiological changes that prepare the animal to stand and face the problem or fly away from the area.

When Epinephrine is release numerous reactions occur, such as

- Increase in heart rate, that result in increased blood pressure and respiration.
- Increase of glucose content in blood to provide a quick energy source.
- Increase of blood flow to the brain

Cortisol

Cortisol is the other hormone released by the inter-renal tissue in response to stress. This hormone prepare the animal to overcome stress. The level of cortisol increase rapidly when fish are crowded together or handled badly. Cortisol can directly interfere with the normal functioning of the immune system, specifically it interfere with the phagocytosis. If cortisol stays for a long time in body it can exhaust the body and cortisol itself become stressors and this exhaustion in the animal leads to the diseases associated with stress,

Physiological changes produced by the cortisol are

- Protein breakdown
- Elevated thyroid hormones
- Biochemical exhaustion

In fish, physiological stress and physical injury are the major factors that cause disease and mortality. In aquaculture fish are confined to the production unit and are weakened by stressors like:

- Increased fish density
- Poor water quality
- Injury during handling
- Inadequate nutrition
- Accumulation of metabolic waste.

These conditions can result in the spread of disease and parasite infestation

Stress and injury initially trigger an alarm reaction (fight or flight response), which results in a series of changes within the fish. A blood sugar increase occurs in response to hormone secretion from the adrenal gland as liver glycogen is metabolized. This produces a burst of energy which prepares the animal for an emergency situation.

In addition, the inflammatory response, a defense used by fish against invading disease organisms, is suppressed by hormones released from the adrenal gland. Water balance in the fish (osmoregulation) is disrupted due to changes in the metabolism of minerals. Under these circumstances, freshwater fish absorb excessive amounts of water from the environment (over-hydrate); saltwater fish lose water to the environment (dehydrate), This disruption increases energy requirements for osmoregulation. Respiration increases, blood pressure increases, and reserve red blood cells are released into the blood stream.

Fish are able to adapt to stress for a period of time; they may look and act normal. However, energy reserves are eventually depleted and hormone imbalance occurs, suppressing their immune system and increasing their susceptibility to infectious diseases.

Effect of stress on protective barriers

Mucus

Stress in fish causes chemical changes in mucus leads to decrease in its effectiveness against invading pathogens. It also upsets the normal electrolyte balance in fish so in freshwater fish the water is absorbed into the body where as in marine fish the water is dehydrated. In addition Handling stress and chemicals used in disease treatment in fish disrupts the physical barrier which makes easy for the pathogens to invade the fish and cause the disease. Stress also cost the fish its energy and also compromise in osmoregulatory function.

Scales and Skin

Handling stress is the most common stress that causes most damage in the scales and skin of the fish. Cut in skin or remove of scale creates an opening for invasion by pathogenic organisms. The infestations with parasites cause damage to gills, skin, fins, and loss of scales which favors bacteria to enter into fish and cause disease in fish.

Immunity

Stress also play its role in immune system among physical stress temperature in particular has a major impact on the immunity. Cold temperature can severely decrease the activity of killer cells which intern affect the immune system. quick decrease in temperature leads to decrease in antibody release in the fish.

Prevention of Stress

To prevent the stress in aquaculture system main emphasis should be given to the water quality, followed by good nutrition and sanitation.