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IMMUNE RESPONSES
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from the blood to the spleen of birds three to six hours after antigen is given, and are genetically modified through the major histocompatibility complex.

Stress And Immunity

Stressors such as heat, cold, crowding, toxins, or behavioral activities depress circulating antibodies and cell-mediated immunities.

A. Thermal Stress — Exposure to temperature above 95 degrees Fahrenheit or injection with ACTH has been shown to depress circulating antibody against a variety of antigens. However, the response is modified by prestress administration of suppressors of corticosteroid synthesis, which demonstrates that immunosuppression is controlled by corticosteroids. Suppression of cell-mediated types of immunity has been demonstrated in fowl exposed to heat or cold. However, effects of acute thermal stress are not always consistent. Such variations have been ascribed to various factors.

1. Genetic differences in the ability of some birds to produce antibody; or genetic differences in ability to respond to stress hormones. Lines selected for high antibody response appear to be more intensely affected by high temperature.

2. Nutrition interacts with environmental temperature to increase or decrease immune status. Restricting feed intake to growing birds if temperature falls below 45 degrees F., or exposing birds to sudden temperature change, results in depressed antibody levels. Deficiencies of a number of vitamins, amino acids, or minerals have been found to be detrimental to immune function.

3. Antigen concentration may also influence whether stress alters immunity. Stress depresses immune response when low doses of vaccines are given, but fails to have an effect when high doses are given. For this reason, producers should be careful to give recommended doses and concentrations of vaccines and not try to dilute the dose or allow the vaccines to degrade due to poor storage conditions. Also, the effects of vitamin deficiency on immunity are greater

at low antigen doses than at higher doses.

4. The immune system interacts with hormonal and nervous systems. In birds, a basic response to cold is increased metabolism. Primary regulators of metabolism are the thyroid hormones, which also increase antibody production. However, blood levels of thyroid hormones decline immediately following antigen injection. Therefore, while antibody levels may increase if birds are exposed to moderately low temperatures, when temperatures become low enough to exceed the ability of the bird to produce sufficient heat, stress assumes greater importance. Such a condition occurs if energy reserves are insufficient, if the normal insulative abilities of the bird are circumvented, or if the temperature control of the bird is immature.

B. Social Environments — Stressful social environments, such as crowding, hysteria, or aggressive behavior, reduce antibodies against a variety of bacterial antigens including Salmonella and E. coli, and against such viral antigens as Newcastle and Marek's disease.

Birds selected for high adrenal response to social stress bind higher levels of corticosteroid in their lymphatic tissues and therefore are more susceptible to stress-induced immune depression. Antibody to *Salmonella pullorum* degrades more rapidly in less aggressive families in socially unstable flocks.

Stress And Disease Resistance

Effects of stress on disease resistance seem contradictory. Resistance to mycoplasma infection, Newcastle disease, hemorrhagic enteritis, or Marek's disease is depressed in birds exposed to

social conflict, but social conflict actually increases resistance to E. coli or S. Aureus in fowl.

Similarly, resistance to parasitic infection is increased by corticosteroid feeding or social stress. On one hand, cold exposure increases susceptibility of chickens to Salmonella infections, while similar conditions increase resistance to *Pasteurella multocida* and Newcastle disease.

The reasons for these contradictions are complex. The effects of corticosteroids on a particular pathology and the associated immune responses are important. In addition to depressing antibody and cell-mediated immunities, corticosteroids also reduce inflammation. Therefore, in diseases where the pathology involves local

or general inflammation, stress often appears beneficial, even when immunity is lower.

However, where defense depends on inflammation to localize infection, stress-caused increases in corticosteroids leads to invasion of the tissue, especially when immunity is also compromised. Moreover, stress-induced reductions in blood lymphocytes and increases in heterophils (see the first paragraph) will increase resistance to bacteria but decrease resistance to viruses.

Therefore, although immune responses are fundamental to disease resistance and do reflect the bird's response to its environment, changes in disease resistance are not always indicative of stress.

Government Must Support U.S.

Agriculture During Transition Period

WASHINGTON, D.C. — The U.S. Government must maintain appropriate policies and programs, including the domestic and export funding that will allow agriculture to compete with the major exporting countries that will seek to maximize their market positions during the GATT transition period, Wayne Boutwell, president of the National Council of Farmer Cooperatives, told the House Ways and Means Trade Subcommittee recently.

The agriculture leader told lawmakers that "agriculture, perhaps more than any other sector of the U.S. economy, understands that its growth potential lies in the global marketplace. As that marketplace becomes less restrictive, the comparative advantage of the U.S. food and agriculture system will reach its full potential," Boutwell said. "However, it is crucial that U.S. trade policies stay in step

with the evolving marketplace."

Boutwell identified several issues of concern to members of the National Council of Farmer Cooperatives, including the disciplining process for export subsidies, the transition for commodities that have tariffed Section 22 protections, special treatment under the tariffication process, scientific standards for sanitary and phytosanitary regulation, and the appropriate role of government in agriculture and food policy.

"The recurring theme through most of these concerns is the willingness of the U.S. government to support the interests of U.S. agriculture," Boutwell said. "U.S. agriculture must have government support within the prescribed limits if it is to compete effectively during and after the transition period. With these issues addressed, NCFC is prepared to support the implementing legislation."

Mechanism And Effects Of Corticosteroids On Immune Cells

Corticosteroids form a complex with receptors in lymphoid cells and then pass into the nucleus of the cell to influence genetic organization. Stress increases the amount of corticosteroid bound in lymphoid tissue cells.

Cellular and hormonal responses begin shortly after antigens, such as Salmonella or E. coli, enter the body. The time and sequence of this response depend on the antigen type, the method by which the antigen enters the body, and the amount of antigen.

For example, within 15 minutes after intravenous injection of *Salmonella pullorum* antigen, plasma corticosteroid begins to rise and reaches a peak within 3 hours. This response is due to ACTH stimulation by the brain neurohormone, corticotropin-releasing hormone.

Certain T-lymphocytes move

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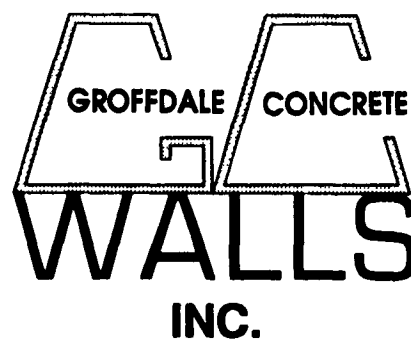
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