Stress in animal production: factors & physiological mechanism

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In this article, common causes of stress in poultry production and their physiological mechanisms are presented.

What is "Stress"?

Generally, the term "Stress" is used to describe the detrimental effects of a variety of factors on the health and performance of living-beings/poultry.

Any slight deviation from normal condition leads to the rapid redistribution of body resources including energy and protein at the expense of growth, reproduction and health (Beck, 1991; Brake, 1987; Gross and Siegel, 1987) (*c.f. step ①: Short term regulation of stress*).

When these challenges come in more intense forms or become more frequent at any given time, serious chemical and physical changes take place within the organism with far-reaching consequences: animals become fatigued and weak. These conditions may lead to birds' starvation and infectious disease (Dohms, 1990; Freeman, 1987).

Types of stress:

It must be acknowledged that there are common sources of stress, which can be grouped under one or more of the following categories defined by Rosales, 1984 and summarized in Table 1.

Table 1: Most common causes of stress and their categorization

Category	Examples
Climatic stress	- Quick weather variation, - Temperature extremes (extreme heat and cold, high humidity)
Environmental stress	- Poor brooding conditions (low temperatures, cold water) - Inadequate ventilation (deterioration of the air quality) - Poor litter conditions (wet and cold), - Bright and excessively long light program,
Nutritional stress	- Feed quality problems (variation in nutrient content) - Quantitative feed and water restrictions [long or uneven feed distribution (split feeding)–> frustration, hunger] - Sex-separate feeding (pressure to restrict body weight gains)

Category	Examples
Physical stress	- Catching, immobilization, handling, weighing, injections, vaccination, grading and transport. - Beak trimming, tail-biting, dehorning
Social stress	- High stocking density (limited feeder and drinker space) - Lack of body weight uniformity (magnified differences in the packing order)
Psychological stress	- humans' fear - harsh caretakers (poor husbandry workforce)
Pathological/immunological stress	- Contaminated premises (built-up litter, early exposure to various disease agents) - Exposure to infectious agents (Clinical or subclinical diseases) - Post-vaccine reactions (fever, reduced feed intake)

In addition to the categories of stress mentioned above, all the possible types of stressors can be broadly classified under two categories (a) avoidable stressors (b) unavoidable stressors (Mohan, 2005) as presented in table 2.

Table 2: Avoidable / Un-avoidable stressors

Although the avoidable stressors can be completely eliminated under efficient management conditions, the load of unavoidable ones can be only minimized highlighting that stress factors are inevitable event in animal husbandry.

Avoidable stressors	Unavoidable stressors
Overcrowding	Extreme weather
Poor ventilation	Handling
Wet litter	Vaccination
Toxins in feed	Transportation
Starvation	Rapid growth breed
High ammonia level	Diseases
Dehydration	Lighting
Poor management	Medication
Abrupt or sudden changes	Hormonal changes

Physiological mechanism of stress regulation

Knowledge of the successive physiological stages occurring within an organism/animal cells under stress is very important to develop and/or propose several solutions that could be combined into effective stress management. (Figure 1: Biological responses to stressor.)

Stress : Three levels of reaction

① ***Short-term regulation of stress*** *(stage of alarm reaction - neurogenic system):*

Also called *"fight or flight"* stage, it lasts only a short time and takes place within sympathetic (post ganglionic) nervous system and adrenal medullary tissue. It controls the

rapid response of the animal (Cannon, 1929), following an abrupt increase in catecholamine (dopamine, nor-/adrenaline) secretion from the adrenal medulla.These neurohormones induce a rapid release of glucose in blood, depletion of liver glycogen, increased peripheral vasomotor activity, altered ventilation rate and increased neural sensitivity (Selye, 1950; Siegel. 1980).

② ***Long-term regulation of stress*** *(stage of resistance or adaptation - endrocrine system):*

This feedback involves the hypothalamus-pituitary adrenal axis (HPA). It is characterized by adrenal cortical hypertrophy and increased synthesis and release of adrenal glucocorticoids - corticosterone in bird (Siegel, 1971, 1980). This hormone is responsible for the formation of glucose from the body's reserve of carbohydrates, lipid and proteins. Corticosteroids contribute also to many of the diseases associated with long-term stress, such as cardiovascular and gastronistestinal disease, hypercholesteraemla, metabolic rearrangements and antibody suppression. (Siegel, 1985).

③ ***Stage of exhaustion*** *(full depletion of body reserves and/or complete sensitivity of infection agents):*

When the stress factors last too long and exceed body reserves or almost causes immunodepression, the third or exhaustion phase leads to fatigue of the homeostatic mechanisms and death (Brake, 1985; Freeman,1987; Maxwell,1993).

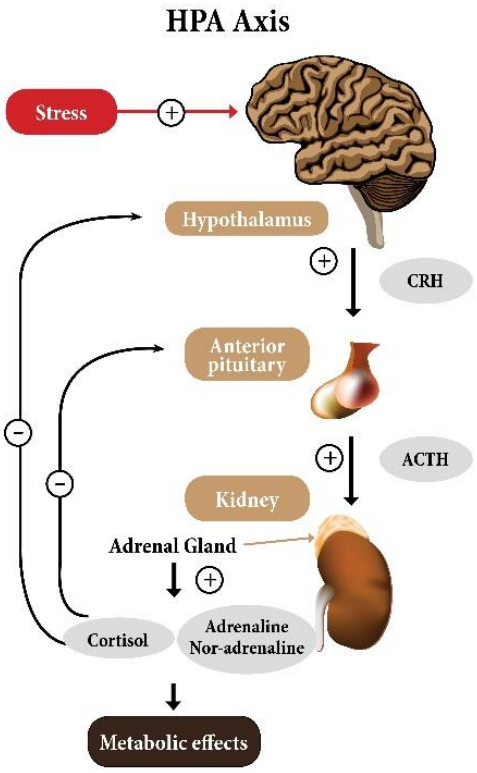

Figure 1: Biological responses to stressors
(HPA : Hypothalamic-Pituitary – Adrenal Axis, CRH : Corticotropin-Releasing Hormone, ACTH : Adrenocorticotroppic Hormone)

Take-home message

The understanding of the physiological mechanism of the stress pathway enables Laboratoires Phode to investigate new areas based on the modulation of the stress message in the brain. Phodé researchers have developed a specific blend of molecules, based on functional olfaction which helps livestock to reduce their stress perception. In addition to efficient management conditions, Phodé sensory solution is an innovative approach to modulate the harmful consequences of stress in high-productivity farming.