How to manage stress factors in poultry production

In modern and large-scale broiler and/or poultry egg production, domestic birds are subjected to frequent stress factors impacting negatively both bird performance and health. An effective management program should start with both the identification and classification of these stress factors.

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Furthermore, the understanding of the physiological mechanism of the stress pathway makes the feed additive industry, and particularly Laboratoires Phodé, able to investigate new areas based on unsuspected innate sense and to select a specific blend of functional molecules as a single and efficient solution to prevent stress in animal production.

In this article, common causes of stress in poultry production, their physiological mechanisms and main indicators in birds 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 poultry.

Birds are characterised with very limited body resources for growth, reproduction, response to environmental changes and defence mechanisms compared to other mammals. Thus, any slight deviation from normal conditions leads to the rapid redistribution of body resources including energy and protein, at the expense of growth, reproduction and health.

When these challenges come in more intense forms or more frequently at any given time, that serious chemical and physical changes take place within the bird with far reaching consequences, birds become fatigued and weak. These conditions may lead to starvation and infectious disease.

Table 1. Most common causes of stress and their categorisation.

Category	Causes
Climatic	Quick weather variation. Temperature extremes (extreme heat and cold, high humidity).
Environmental	Poor brooding conditions (low temperatures, cold water). Inadequate ventilation (deterioration of the air quality). Poor litter conditions (wet and cold). Bright and too long light program.
Nutritional	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).
Physiological	Rapid growth, process of maturing sexually (strict nutrient demand). Sexual maturity and onset of egg production (drastic stimulation with feed and light).
Physical	Catching, immobilisation, handling, weighing, injections, vaccination, grading and transport. Beak trimming.
Social	High stocking density (limited feeder and drinker space). Lack of body weight uniformity (magnified differences in the packing order).
Psychological	Human fear. Harsh care takers (poor husbandry workforce).
Pathological/ immunological	Contaminated premises (built-up litter, early exposure to various disease agents). Exposure to infectious agents (clinical or subclinical diseases). Post-vaccinal reactions (fever, reduced feed intake).

Types of stress

It must be acknowledged that there are common sources of stress, which can be grouped under one or more of the categories defined by Rosales (1984).

These are summarised in Table 1.

Focus on climatic stress

High ambient temperature in the tropics accompanied by high relative humidity is one of the most important stressors.

Birds are more susceptible to high environmental temperature than low environmental temperature due to the absence of sweat glands in the feathered body, fatty nature and high body temperature (40.1°C to 41.6°C).

The degree of susceptibility to tropical heat stress is higher in broilers than layers.

Among broilers, males are more susceptible to heat stress than females. Good layers housed in cages are more susceptible than poor layers reared on deep litter.

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

If the avoidable stressors can be completely eliminated under efficient management conditions, the unavoidable ones can be only minimised, highlighting that stress is an inevitable event in poultry husbandry.

Physiological mechanism of stress regulation

The knowledge of the successive physiological stages happening 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 (see Fig. 1). There are three levels of reaction to stress:

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

Also called the '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, following an abrupt increased rates secretion of the catecholamine (dopamine, nor-/adrenaline) from the adrenal medulla.

These neurohormones induce a rapid release of glucose in the blood, depletion of liver glycogen, increased peripheral vasomotor activity, altered ventilation rate and increased neural sensitivity.

- **Long-term regulation of stress (stage of resistance or adaptation – endocrine system):**

This feedback involves the hypothalamus-pituitary adrenal axis (HPA). It is characterised by adrenal cortical hypertrophy and increased synthesis and release of adrenal glucocorticoids – corticosterone in the bird.

This hormone is responsible for the formation of glucose from the body's reserve of carbohydrates, lipid and proteins. Corticosteroids also contribute to many of the diseases associated with long-term stress, such as cardiovascular and gastrointestinal disease, hypercholesteraemla, metabolic rearrangements and antibody suppression.

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

When the stress factor lasts too long and exceeds body reserves or

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almost depresses the immune system, the third or exhaustion phase leads to fatigue of the homeostatic mechanisms and death.

Physiological indicators of stress in poultry

Several workers have reviewed the effect of stressors in fowl and the following indicators of stress in birds have been highlighted:

- Atrophy of the thymus and atrophy of the bursa of Fabricius in young birds, enlargements of the anterior pituitary and the adrenal glands.
- Depletion of the adrenal cholesterol. An increased level of plasma corticosterone, insulin or glucagon.
- Increased reliance on glucose as an energy source.
- Hypoglycaemia (increased glucose utilisation).
- Decreased growth and increased muscle degradation.
- Release of acute-phase cytokines (monokines and lymphokines)
- Impaired growth of cartilage and bone.
- Synthesis of specific heat shock proteins.
- Decreased voluntary feed intake (anorexia).
- Increased body temperature.
- Changes in the level of plasma metabolites (for example glucose, tryglyceride, non-esterified fatty acids and lactate).
- Epinephrine content in yolk of donor hens.
- Changes in the number of circulating leucocytes profiles (heterophil: lymphocyte ratios and basophil and eosinophil numbers).
- Immunosuppression.
- Excess fat deposition in the abdomen (abdominal fat pad).
- Ascites (water belly) in high producing broilers.

Most of the research work on stress and its management in poultry has been conducted in temperate climatic conditions. Reports are also available on stress management in tropical climatic conditions. The following works have been done in this regard:

- Work carried out by Moudgal et al (1991) indicated that immobilisation stress for 30 minutes daily caused apparent decline in egg production.

They also established the inter-relationship between the duration of rapid growth of ovarian follicles and egg production under conditions of stress and during advanced age.

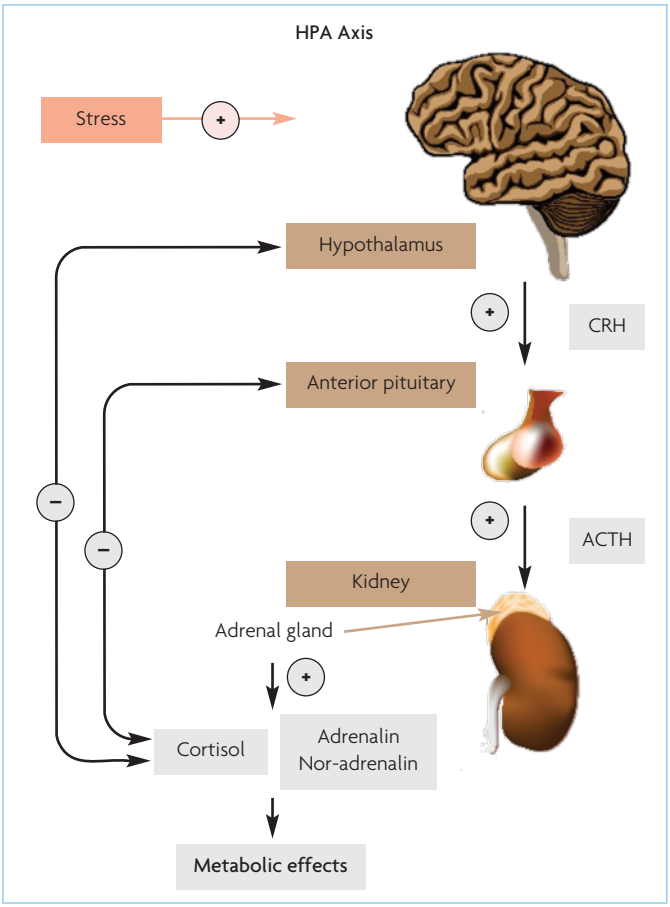

Fig. 1. Biological responses to stressors (HPA: Hypothalamic-Pituitary – Adrenal Axis, CRH: Corticotropin-Releasing Hormone, ACTH: Adrenocorticotropic Hormone).

- Effect of starvation and high cage density on semen characteristics of healthy broiler cockerels was investigated by Mohan et al (1993).

They investigated that semen volume, sperm concentration and angiotensin-converting enzyme activity (ACE, EC. 3.4.15.1) showed a significant ($P<0.05$) decrease on the seventh day followed by cessation of semen ejaculation on day 15 of starvation.

The influences of high cage density on sperm concentration and ACE activity were not detected by 24 weeks of age.

However, these parameters reduced significantly ($P<0.05$) at 27 and 30 weeks of age in comparison to control birds.

Thus, both starvation and high cage density were found to be associated with the deterioration of semen quality.

- Catecholamines have been well implicated in mediating stressful conditions. Alteration of catecholamines metabolic biosynthesis through dietary L-dopa fortification in laying quails and then observation on its production traits were assessed. Increased level of L-dopa showed trends of lowering adrenal and liver weight, but increasing dopamine, nor-epinephrine and epinephrine concentration in egg yolk as well as egg number.

Under efficient managemental conditions, avoidable stressors can be eliminated. Genetics has increased potential productivity but still the attention should be directed on unavoidable stressors in poultry husbandry in order to minimise their impact on production performance.

Table 2. Avoidable/unavoidable stressors.

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

Innovative development

Laboratoires Phodé have designed VeO, an innovative neuro-sensory feed additive that reduces broilers' stress perception and thus induces behavioural and physiological adaptations when facing stressors throughout their life cycle.

Mainly composed of a specific vegetal extract from the rutaceae family well-known for its anti-stress benefits, VeO has been tested in various stress situations found in breeding environments: stress caused by heat, handling, re-grouping, response to vaccinations, etc.

Intensive broiler production needs a high stocking density for barn productivity, but this lead to a high level of stress perception.

In a high stocking density stress experiment (Chonbuck University of Korea), at week five, the feed intake decreased and the growth performance was lower as a consequence of this high level of stress perception. Indeed, preening behaviour at week four showed a high level of stress with decreased activity.

In the situation of high stocking density, VeO allows better preening behaviour to be exhibited. VeO also allows better feed intake and significantly higher growth performance to be achieved.

This experiment demonstrated the relationship between stress and performance. Stress always reduces performance, but the addition of VeO reduces the perception of the stress allowing the main part of the performance to be recovered.

The goal of poultry scientists should be to strike a balance between hypo-and hyper-stress, to find as much eustress as possible and to minimise distress. The ultimate aim of successful poultry husbandry is not to eliminate stress but to maintain it at an optimum level for good production efficiency.

Laboratoires Phodé focuses on modulating stress perception through good functional sensory solutions. ■

References are available from the author on request