Reducing the impact of stress on broiler breeders

by Alwyn Havard, Havard Associates International, UK.

The primary objective of broiler breeders in rearing is to have them consume a restricted quantity of nutrients within a limited time interval and be able to produce a uniform flock of hens whose weight, body condition and skeletal frame allow the reproductive organs to develop, mature and function in an optimum way.

The primary objective during lay is to produce fertile eggs and ideally the entire flock will reach sexual maturation on time and be ready for photo stimulation. This increase in light activates the release of hormones which stimulate ovarian production and early follicular development.

Any exposure to stress during this critical stimulation phase can limit the effectiveness of the response to hormonal release and reduce the opportunity to reach the maximum peak production and produce the largest number of hatching eggs.

On many farms feeding programs have difficulty in providing the correct amount of feed evenly distributed to all birds and this leads to under and overfed birds. The under-fed birds are not fully developed to respond to the light stimulus, whereas the overfed birds are too heavy due to excessive body fat and an over-stimulated reproductive system.

Table 1. Different physiological effects of stress in poultry.

- Increased levels of corticosterone, insulin or glucagon
- Increased metabolic rate and resting energy expenditure
- Increased reliance on glucose as an energy source
- Elevation of plasma free fatty acids (decreased usage)
- Hypoglycaemia (increased glucose utilisation)
- Decreased growth and increased muscle degradation
- Release of acute-phase cytokines (monokines and lymphokines)
- Impaired growth of cartilage and bone
- Redistribution of trace minerals
- Synthesis of specific stress proteins
- Decreased voluntary feed intake (anorexia)
- Increased body temperature
- Immunosuppression

- Sexual maturity and onset of egg production (drastic stimulation with feed and light)
- Lack of body weight uniformity (magnified differences in pecking order)
- Lack of skeletal frame uniformity (variation in calcium supply and shell quality)
- Rapid growth (strict nutrient)
- High stocking density (limited feeder and drinker space)
- Quantitative feed and water restrictions (frustration, hunger)
- Excess of one feed ingredient (disrupts digestion and metabolism)

Table 2. Some of the most common causes of stress in broiler breeder flocks.

Overstimulation causes stress and leads to an increase in double yolkers, variation in egg weight (poor uniformity) and short clutch lengths (egg sequence) followed by a rapid decline in egg production as the birds become older (post 45 weeks).

Variation in egg shell structure and colour will occur together with the (partial) absence of the shell cuticle which is the first line of defence from bacterial contamination. Eggs with missing cuticle reduce the integrity of the shell structure and have a much higher risk of bacterial contamination.

The bacteria can build up in the contaminated eggs and result in eggs exploding during transfer and hatching. The circulating bacteria within the hatcher can then infect susceptible chicks with unhealed navels.

Larger eggs with poor shell integrity are susceptible to damage and cracks leading to early bacterial contamination which cause embryonic mortality. The larger eggs (more egg weight with less dense shells) also impacts negatively on embryonic development and resulting chick quality.

The stress of overstimulation can also lead to egg prolapse and peritonitis as the egg production increases rapidly. The daily feed requirement of these larger overweight birds is increased above an economic level and there is no possibility of reducing the daily feed allocation. At the same time the poorly developed birds miss out on reaching their physical (and sexual) maturity to coincide with the optimally developed hens of the flock and will produce a reduced number of smaller eggs.

Size influences quality

Chick quality is vital to the successful performance and survival of broiler chicks but many factors interfere with the process of achieving this goal.

In the field we often see that chick quality from an older flock is not as good as we would like and although the chicks are big, problems with the viability of the chick, yolk absorption and unhealed navels are observed together with decreased hatch of fertile eggs and an increase in 'late deads'.

It is generally accepted that as flocks become older they lay larger eggs. But, in the majority of breeder flocks the egg weight (size) is much larger than the breed standard egg weight profile.

Despite the variation in the physical characteristics of these larger eggs, which have considerable influence on the successful development of the embryo and subsequent chicks, the broiler producer prefers to receive chicks hatched from larger eggs (older flocks).

It is generally assumed that egg weight and day old chick weight are closely correlated and that chick weight can be used as a reference of good chick quality in the hatchery.

However, this can be misleading as the body weight can include the weight of the unabsorbed yolk sac.

The residual yolk sac indicates that the embryo could not fully utilise the energy by burning yolk fat during the incubation and hatching processes resulting in lower number of viable chicks being hatched.

Lourens et al (2007) have demonstrated that the true chick weight is a yolk sac free chick body weight and that the true measure of efficient embryo development is the

Continued on page 13

Continued from page 11
chick length measured from the tip of the beak to the toe in centimetres.

They demonstrated that chicks hatched from eggs produced by high yielding breeder flocks at 30 weeks of age (average egg weight of 58g) had residual yolk varying between 1.5g and 6.5g and that the chick length positively correlated to yolk free body weight and negatively to residual yolk weight.

The consequence of residual yolk is far reaching as the unabsorbed lipids of the yolk sac interferes with the early digestion of carbohydrates of the chick starter feed, which is crucial to the early development of the intestinal villi and immune status of the chick. The effect of egg size on heat production and the transition of energy from egg to hatchling has been demonstrated. Large eggs produce more heat than small eggs and large eggs also face more difficulties to remove the surplus heat from the egg.

If large and small eggs are incubated under similar conditions the higher heat production and increased difficulties to remove heat in large eggs will result in higher embryo temperatures in these eggs.

The influence of embryo temperature on embryo development is shown by Lourens et al (2005). To our knowledge the effect of egg size on embryo development and hatchability has never been studied.

Impact of stress

The term 'stress' is commonly used to describe the detrimental effects of a variety of situations on the health and performance of poultry.

Birds have limited body resources for growth, reproduction, response to environmental changes and defence mechanisms. When subjected to stress they undergo a variety of internal and hormonal responses. Necessary adjustments for survival require the bird to use energy and other nutrients intended for growth, immunity, feathering and reproduction.

The sudden release of stress hormones (catecholamine and corticosterone) immediately overtake other biological functions and disturb the formation of glucose from the body's reserves of carbohydrates, lipids, and proteins.

Recent studies have demonstrated that birds are very sensitive to the effects of corticosterone and similar substances referred to as gluco-cortiscosteroids.

Reducing stress

Although every attempt is made to minimise the level of stress that broiler breeders are subjected to there are also unseen stressors that have a negative effect on essential biological processes which cannot be ameliorated through daily adjustments in bird management.

The maintenance and growth of the bird's biological system requires the proliferation of many cells. Cell proliferation is a lengthy and complicated process dependent mainly on energy and the supply of specific building blocks, nucleotides.

Nucleotides

Nucleotides work directly on immune enhancement under conditions of metabolic stress, intestinal stress and tissue regeneration to intestinal balance and repair of the villi. They are biochemical compounds providing basic building blocks for cell multiplication in fauna and flora. Cell multiplication, imperative to the life of all organisms and fundamental to their biological functions, is wholly dependent on nucleotides.

Unhindered cell multiplication is a prerequisite for growth, repair, disease resistance, healing and pre-eminent function of organs and regulatory systems (for example the immune system).

Moreover, nucleotides are found in DNA, RNA and a variety of other molecules essential for energy metabolism or digestion of nutrients. The assumption that all organisms can supply sufficient amounts of nucleotides to meet their physiological demands was recently refuted. The recycling of nucleotides from dead cells ('Salvage Pathway') or the biochemical de novo synthesis are sufficient under 'normal' conditions only. The internal nucleotide pool needs to be filled to provide enough nucleotides to cover cellular and molecular processes involved in performance, immune response, development and stress handling.

However, under increased requirements, for example a health challenge or the omnipresent stress in poultry systems, the internal production of nucleotides does not supply sufficient amounts of nucleotides to meet this demand. Therefore the supplementation of nucleotides in the feed is necessary.

Nucleotides play a vital role in cell multiplication and provide energy and nutrients for the bone marrow of the skeletal frame to function efficiently ensuring a continuous supply of calcium for egg shell formation and the replacement of red and white blood cells required for the retention of oxygen, efficient digestion and maintaining an effective immune system, as well as other biological functions.

Alleviating stress

Evidence demonstrates that stress is an important cause of reduced flock performance and increased susceptibility to disease. Until recently, antibiotics as well as other antimicrobial products were used to compensate for the impact of stress and an attempt to prevent secondary infection. The technical performance of these flocks was often relying on a constant course of medication to try to maintain a positive economic outcome and minimise mortality.

As the selection pressure of the broiler genotype traits continue to select for growth and meat yield the physiology and metabolism of the breeder is elevated and this diminishes the bird's competence to develop its adaptive immune system.

The use of antibiotics and other antimicrobials are now seen to become ineffective

Continued on page 15

Fig. 1. Egg weight compared to Ross target.

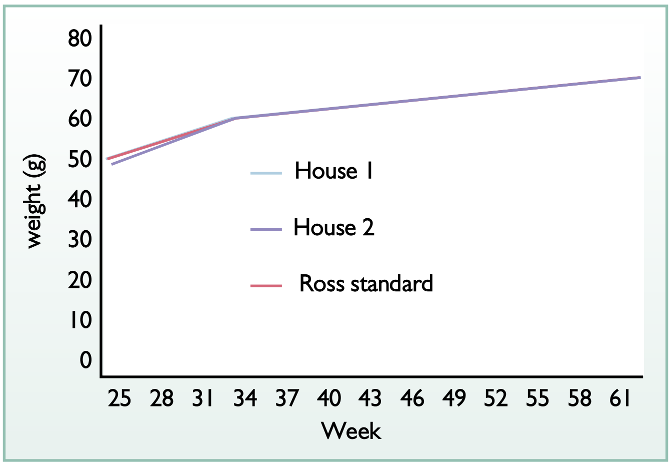
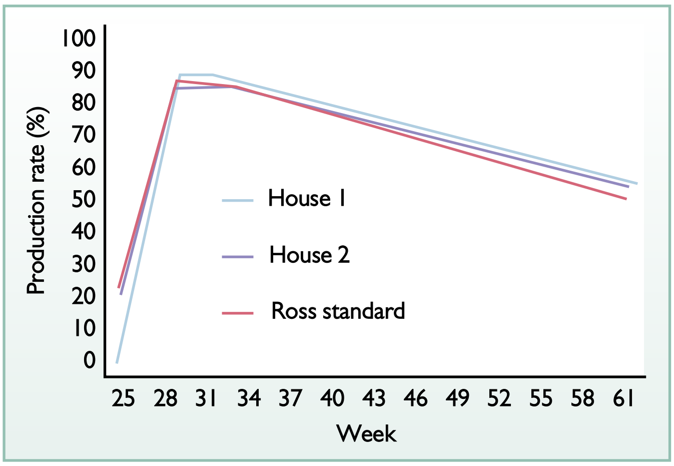


Fig. 2. Production rate compared to Ross target.



Continued from page 13
(antibiograms) due to the resistance of the bacterium to virtually all available antibiotics.

Today, broiler breeder management includes practices that under certain conditions are stressful to the flocks. Obviously there are cost factors and practical limitations to providing non-stressful management.

However, it is important to note that the economic and social trends of today's poultry industry require quality products at the lowest possible cost without any harmful health or environmental effects.

The supplementation of nucleotides in the feed meets these requirements and is an economic and effective tool.

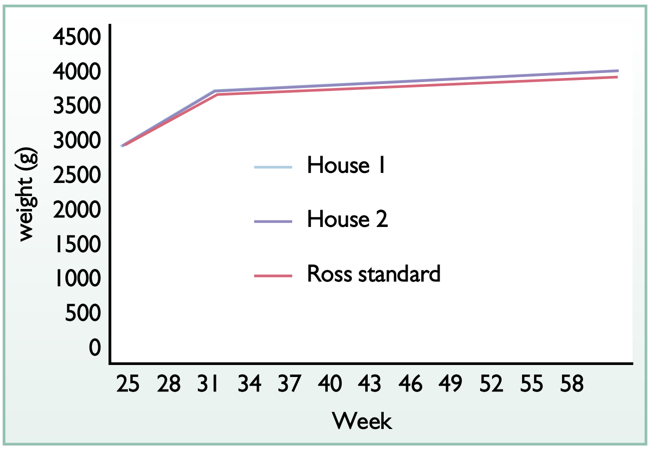


Fig. 3. Bodyweight compared to Ross target.

Broiler breeder trial

The objective of a broiler breeder trial carried out in the Netherlands in 2008 was to test if nucleotides can minimise the impact of stress and improve the broiler breeding process.

The trial used two identical commercial breeder houses, with separate sex feeding, each house accommodating 11,060 hens and 1,104 cockerels of Ross 308 (sister flocks from the same GP flock), transferred at 19 weeks, fed on standard breeder formulations including supplementary nucleotides from Chemoforma at 0.5kg/ton for the entire breeding cycle to 62 weeks.

A monitoring program was installed to check on the daily changes in body weight increase (male and female separately), egg numbers, egg weight (size), shell quality, percentage of double yolkers, feed amounts and cleaning up time together with other management inputs. Feed and light increases (and feed decreases) were made based on the observations of the body weight development and condition, egg weight and rate of increase of egg production.

Husbandry and feed management objectives focused on:

- Feed utilisation.
- Body weight development.
- Controlling egg size, shell quality and colour.
- Producing the maximum number of hatching eggs.
- Highest fertility percentage.
- Highest hatchability percentage.
- Highest chick quality percentage.

Daily flock data from the monitoring system was circulated to the Lagerwey BV hatchery and supporting team members, providing advice and assistance to the flock farmer during the period of the trial.

Table 3. Trial performance details.

	House 1	House 2
Total eggs/hen	182	174.28
Feed/hen (kg)	47.6	47.6
Feed/egg (g)	262	274
Mortality (%)	6.9	8.75

The Ross 308 breed targets for body weight, egg weight, egg production and hatchability were used to influence changes in feed and bird management.

The results from the trial were compared with the Ross 308 Performance objectives.

Results of the trial

The two Ross 308 flocks (House 1 and House 2) responded well to the combination of correct management, feed composition and feeding strategy. They performed well in relation to the Ross performance objectives in both House 1 and 2 at 62 weeks of age:

- Egg production index from 26-62 weeks = +4.8%.
- Egg production index from 42-62 weeks = +6%.
- Egg production persistency post 32 weeks = +5.5%.

The careful stimulation of the flock ensured that the percentage of 'double yolked eggs' was reduced to a minimum 0.26%. Egg size (weight grams) was optimal and followed exactly the Ross performance objectives.

- Egg shell quality, colour and cuticle improved with very low rejects = 0.021%.
- Fertility = 88.39%.
- Chicks = 84.02%.
- Chick numbers per hen = 141.7.
- Late deads = 4.37%.
- Hatch of fertiles = 95.14%.

In House 1 the health status was very good and flocks only required routine worming.

In House 2 in the early period of lay E. coli treatment was required followed by routine worming. Flocks recovered well after treatment and continued to perform to Ross targets. Both flocks received water soluble vitamins to support various treatments.

The nucleotide product was included at 0.5kg/ton in all feeds from 20-62 weeks. The cost is equivalent to two hatching eggs.

The bird weighing system and slaughter house confirmed that the hens were +130g above the Ross bodyweight profile for the entire laying cycle.

This trial met all the Ross 308 broiler breeder production targets compared to current results in the hatchery group:

- +6.7 HE/HH.
- +4.12% hatchability/HH.
- +3.94 more chicks/HH.
- 3kg/HH= feed saving.

Conclusions

The results of this trial support the opinion that it is possible to achieve optimum performance from broiler breeder flocks housed and managed within the stressful environment of the breeder house. The supplementation of nucleotides in this feed trial helped the flock farmer and the birds to minimise the effect of stress and make steady progress in their physical and biological development enabling the flock to reach the optimum physique and sexual maturity ready for photostimulation.

The uniform body development ensured an adequate skeletal frame whose bone matrix was essential for calcium storage and to support the high production of hatching eggs. The nucleotides also compensated at critical times when the stress challenges increased rapidly due to onset of lay and high egg production, thereby minimising the impact of catecholamine and corticosterone hormones

The treatment supported the availability of energy to maintain cell multiplication of the digestive, lymphatic, hormonal and immune systems allowing the transfer of adequate lipoproteins, micro nutrients and parental antibodies via the egg to the embryo for the emerging chick to be well developed and free from infection. This was confirmed by good hatchability, good chick quality and high percentage hatch of fertile eggs. Reports from the broiler growers of chicks from these flocks confirmed the quality and health status, as the seven day mortality was not higher than 0.13%.

Egg size was controlled exactly within breed target, excellent shell texture and colour was achieved during the laying cycle and contributed to the uniform effect of single stage incubation controlling embryo temperature throughout the incubation process.

Good shell quality also assisted the hatchery manager to achieve the necessary water loss during the incubation and shorter hatching process. Both flocks made better utilisation of the feed resulting in a lower quantity required per hen (compared to Ross target) and feed per hatching egg.

Good immune status was supported by the nucleotide inclusion in achieving good titre readings for the routine vaccinations carried out on the flocks. ■