Management of breeder body weight to ensure sustainable performance

Egg and poultry meat demands should meet a sustained and continuous growth in the years to come. Day-old chick producers are continuously looking for new solutions to help them answer their zootechnical and economic objectives. The management of feeding strategies is a key point to well regulate growth and reproduction.

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Over the last 50 years, broiler body weight has increased over 450%, but the body weight target considered optimal for broiler breeder reproductive efficiency has remained virtually constant. Thus, the gap between the growth potential of broilers and broiler breeders target body weight is increasing.

Nutrition and, more precisely, energy metabolism influences reproduction. That is why one of the biggest practical contemporary challenges facing broiler breeder producers is achieving high flock uniformity considering female body weight to ensure sustainable performance.

Overweight and female reproductive troubles

The effectiveness of selection has led to having fast growth birds, while minimising energy expenditure. This suggests different metabolic management than other lineages such as egg lines.

Although the production of an egg is a process that requires a lot of energy, an excess of energy leads to an increase of female body weight and literature has demonstrated its negative consequences on egg production.

For immature females this can lead to an accelerated development of the reproductive system at sexual maturity and to an ovarian hyperactivity. It may also decrease the production of functional oocytes by causing a deregulation of the follicular hierarchy. It generates an anarchic development of the follicles which can lead to the coexistence of several follicular hierarchies disturbing the ovulation.

The greater frequency of multiple ovulations or close ovulation leads, in particular, to a greater incidence of abnormal eggs (deformed, soft).

Multiple ovulations cause the appearance of 'double eggs' (double yolks), whereas close ovulations usually lead to the appearance of a first 'normal' egg, the second being then smaller, deformed and presenting defects of calcification.

An explanation has come from a study which investigated the effect of overfeeding on lipoprotein production (main yolk compound) in the liver. Their model showed the laying hen had an increase of VLDL-like lipid vesicles diameter (lipoproteins family), which normally have an identical size of approximately 30nm. The alteration of their physicochemical properties modify their blood transport to the follicles under development leading to a stop of yolk deposits in the growing follicles.

Consequently, it is really important to take care of the feeding strategy to feed male and female breeders to ensure the best fertility rate and obtain the highest number of day-old chicks leading to higher economical profitability.

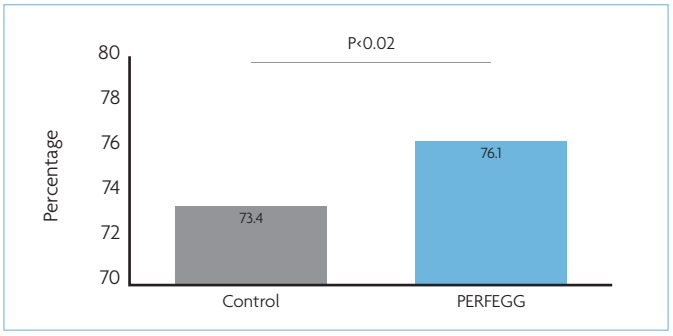

Fig. 1. Female fertility rate.

Hen physiology

The formation of eggs requires a very high level of energy and nutrients. A study evaluated the energy level needed to produce one egg at 102kcal. It represents one third of the total amount of energy ingested daily by the hen.

These huge energy requirements involve a high energetic and physiological metabolism.

The formation of the egg is not just associated with two different anatomical structures, which use an enormous amount of nutrients: the ovary for the yolk and the oviduct for the albumen and the eggshell.

The liver is also a key organ implicated in the hen's metabolism which needs to be healthy. The liver provides nearly all the basic nutrients for the development of the yolk and albumen and supports the development of the eggshell.

A liver remaining healthy allows good egg production with excellent eggshell quality. When the liver is suffering, production and egg quality are directly affected.

The source of energy influences the liver function. Energy can come from lipids, proteins, carbohydrates and sugars. The liver will directly or indirectly use these nutrients to build lipoproteins (main compounds of the yolk) which will be transferred from the ovary by the blood. From a metabolic point of view, the building of lipoprotein from lipids is very easy for the liver.

On the other hand, building lipoproteins from an excess of carbohydrates, sugars and proteins is stressful and metabolically costly for the liver. Unlike other species, such as ruminants and pigs, birds have a very low capability to biosynthesise de novo triglycerides in adipocytes.

This explains why hens maintain a high blood glucose concentration to cope with the enormous challenge of lipogenesis for egg formation. So, hens are highly subjected to type II diabetes.

Thus, diets rich in fat help to keep the liver healthy but are very expensive because of the formula cost. However, the diet contains mainly cereals rich in carbohydrates such as cellulose and starch. That is why a hen needs to synthesise de novo fatty acids in the liver to meet lipid requirements for producing an egg.

Furthermore, there is a di-synchronicity between the feed intake and the moment when the egg is being constructed (continuously over the day) meaning the liver is solicited throughout the day. In case of excess energy consumption, birds can store it in

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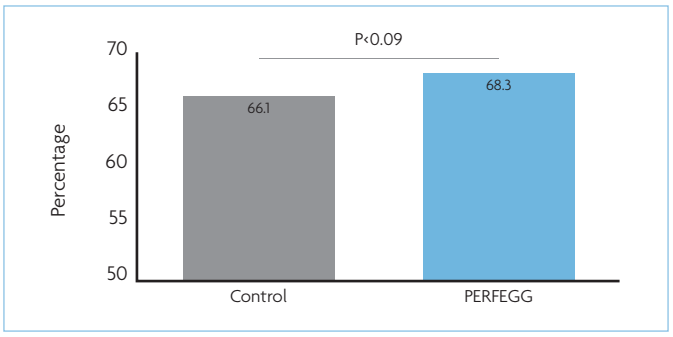
Fig. 2. Hatching rate.



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the liver via a phenomenon called hepatic steatosis, which leads to fatty liver syndrome.

A fatty liver lowers egg production, increases mortality, decreases eggshell quality and alters carbohydrate and fat metabolism, affecting reproductive parameters.

The regulation of the lipoprotein metabolism and, more generally, the production of eggs are under the control of two main hormones – insulin and oestrogen.

Type II diabetes

When not enough insulin is produced or when the body cannot effectively use it, type II diabetes occurs and corresponds to a prolonged elevation of blood sugar named hyperglycaemia.

This pathology is derived from a carbohydrate metabolism disturbance appearing progressively.

Diabetes is promoted by a decrease of sensitivity of cells to insulin (insulin-resistance) especially when overweight is observed.

Insulin production becomes insufficient and leads to an accumulation of glucose in the blood which can no longer be used by the liver, muscle and fat tissue cells, leading to a disturbance at the physiological level as glucose is the main 'oil' of the cells.

Hepatic fat accumulation is a complication of diabetes. An increase of fat transport to the liver is observed associated with a decrease in removal of fat from the liver. This explains the fatty liver syndrome occurring at the end of the production period.

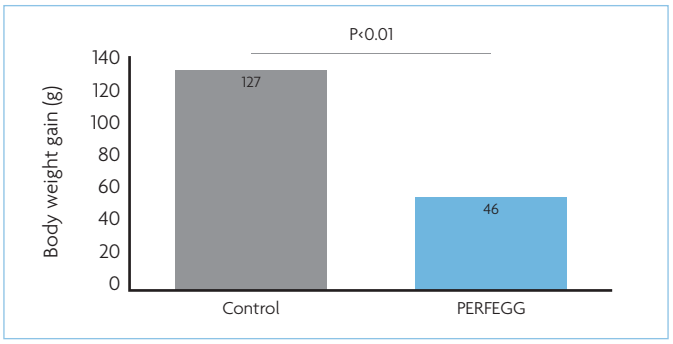

Fig. 3. Body weight gain.

The late laying phase

The late laying phase is a critical period where a natural decline of reproductive efficiency of breeders is observed.

These events are often correlated with a fatigue of the hen leading to a disturbance in carbohydrate and fat metabolism and to a difficult management of the female body weight. At this stage, the severity of diabetes increases and is physiologically translated into a decrease of performance (reduction of egg production, apparition of fatty liver syndrome, hens are heavier and fertility rate is reduced).

To support this specific phase, a solution based on an innovative vegetal active ingredient named PERFEGG has been developed by Wisium.

It helps producers to maximise their profitability by answering the following five objectives:

- Limits body weight gain.
- Improves female fertility.
- Increases the number of eggs produced.
- Improves hatching rate.
- Increases the number of day-old chicks.

A recent trial run with breeders in a French R&D facility highlighted the benefits of PERFEGG on the significant increase of female fertility (+2.7pts), and an improvement of the hatching rate by +2.2pts.

This involved the production of +1 day-old chick per hen after 10 weeks of supplementation.

By reducing the prevalence of type II diabetes, PERFEGG improves fat metabolism in the liver and the formation of egg yolk. More lipoproteins are synthesised in the liver and exported in the ovary tract leading to a better homogeneity of the ovary.

Consequently, egg production is increased, and more day-old-chicks are produced. By better management of the body weight gain associated with better fat metabolism, female fertility is increased. In this trial, PERFEGG significantly limited the body weight gain of the female.

With a potential return on investment higher than three, PERFEGG is a safe and profitable solution to improve the economic performance of day-old chick producers. ■