Split feeding – the concept and benefit for laying hens

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The conventional feeding method for laying hens is to provide a single complete feed during the whole day. The feed is easy to produce in large quantities for a feed plant and only one silo is required at farm level. However, due to egg formation, the bird's metabolism differs during the day. Up to now, improvement of the production costs has been done by increasing bird productivity. Another way to reduce production cost is to work on feed by optimising the use of nutrients according to birds' metabolism. Moreover, with the trend to extend the production cycle and the target to reach 500 eggs at 100 weeks, eggshell quality will become a key point to control in order to succeed. The split feeding technique can meet these stakes. Basically the concept of split feeding is to provide different types of feed during the day according to the bird's metabolism. To do it, several silos must be available and combined with an automatic system to switch from one feed to another.

Calcium metabolism

During eggshell formation, which occurs mostly during the night, the calcium requirement is high. Birds have two different sources of calcium to build the eggshell. Calcium could come directly from the feed or could be mobilised from the medullary bone.

According to the source, eggshell quality will not be the same. The higher the proportion of calcium coming from the feed, the better the eggshell quality. When birds are forced to mobilise the calcium from the medullary bone, phosphorus is released at the same time. The phosphorus blood concentration increase leads to lower ability to mobilise bone calcium and increase the requirement in phosphorus.

On the morning when the eggshell formation is finished, birds are rebuilding their bones with phosphorus and calcium consumed in the morning.

So birds have a high requirement of calcium and a low requirement in phosphorus during the night and the opposite in the morning (high phosphorus/moderate calcium). The excess of calcium consumed in the morning which is not used, will go through the digestive tract and be found in the manure.

All techniques to increase the calcium crop content before the night have a positive effect on the eggshell quality. It has been known for a long time, that end of the day calcium supplementation could be enough to support a good eggshell quality without affecting performance.

Energy

The lipoproteins of the yolk are continuously synthesised in the liver and accumulated in the follicle until ovulation takes place. Consequently, there is no peak of energy requirement link to egg formation.

When we compare bird feed consumption according to the period of the day, we can observe a big difference for birds in lay or not. Birds in lay significantly increase their feed consumption before the night and early morning. This difference is linked to a specific appetite for calcium during the eggshell formation and not directly to an increase of the energy requirement or energy storage before the night. When birds are in lay, energy requirement and/or consumption seem not to be very variable according to the period of the day.

However, several trials investigating split feeding have noticed a reduction of the energy consumption when two different feeds were delivered during the day. It is difficult to conclude, but we know birds have some preferences for big particle size and feed presentation change could lead to a decrease in feed intake. Are the lower feed and energy consumptions observed linked to better energy efficiency? Or, are they linked to a 'transition' effect (lower preference for one feed)? Anyway, feed and/or energy consumption are reduced with split feeding and production costs decreased.

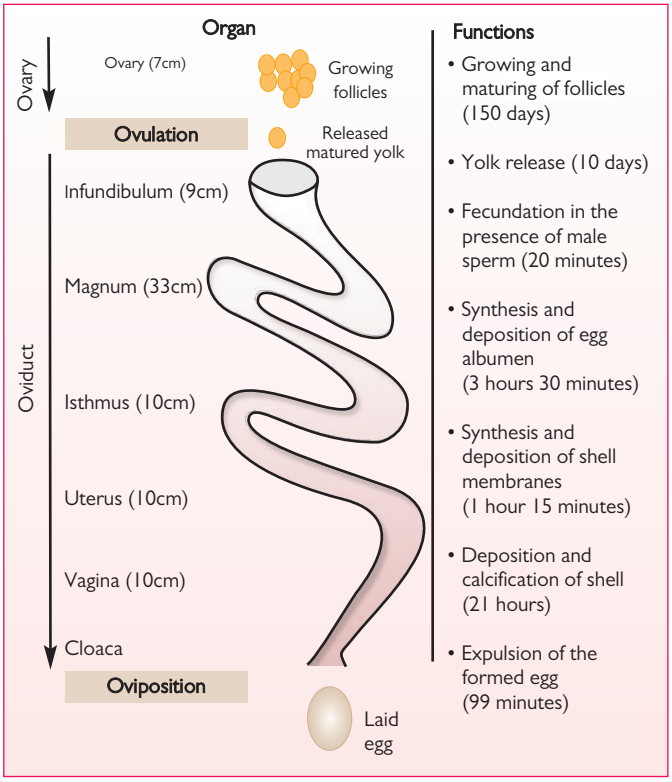

Fig. 1. Egg formation (Umar Karuk 2010).

Table 1. Effect of different morning and afternoon calcium concentration on shell quality (Lee 2002 WPSA Asia Conference).

Calcium level (%)		Egg shell gravity	Percentage of shell
Morning	Afternoon		
3.5	3.5	1.081	9.49
2.0	5	1.082	9.62
0.5	6.5	1.084	9.71
0.5	8	1085	9.83
0.5	9.5	1.086	9.81
0.5	11	1.086	9.91

Protein and amino acids

Synthesis and deposition of egg albumen last approximatively three hours and 30 minutes and occur in the morning. 70% of egg white protein is synthetised in the oviduct directly.

To be able to make this egg white protein, amino acids must be available at this particular moment in the oviduct; otherwise egg white and egg size are reduced. This suggests that birds must have access in the morning to a feed rich in protein and amino acids. As the requirement is

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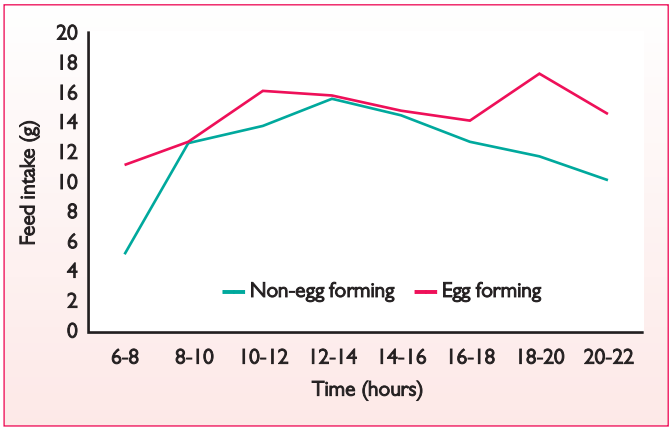

Fig. 2. Feed intake per period of the day of birds laying or not (Chah and Moran, 1985).

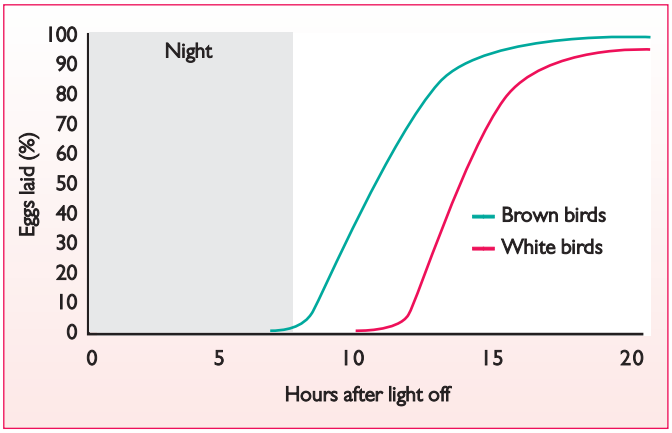

Fig. 3. Difference in laying period between brown and white birds (Joly, 2001).

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lower in the afternoon, protein and amino acids concentration could be lowered in the afternoon feed.

Difference in colours

White and brown birds are not laying at the same time. Brown birds are laying earlier and close to 10% of the birds have already laid before lights on. For most of them, the calcium ingested in the morning will not be used to produce the eggshell. So, in case of split feeding, the low calcium morning feed could be distributed after lights on for brown.

White birds are laying almost three hours later compared to brown. The calcium ingested early in the morning is used to finish the eggshell. Then, in case of split feeding, for optimising the eggshell quality, the first feed distributed in the morning must be rich in calcium. The nutritional strategy used for brown and white birds must be different.

Worldwide, different types of split feeding are used. The simplest one is just the supplementation of coarse limestone in the last feed distribution(s) of the day. Practice called the '3-3-3' technique (3g of limestone, 3mm limestone diameter, at 3pm).

In some countries, a special complete feed is delivered in the morning and late in the afternoon, with the main characteristic to be rich in calcium. The rest of the day, cereals grinded in coarse particles are delivered. The more complex split feeding is to have two different feeds adapted to the bird's physiology, as described previously.

Split feeding decreases production cost by improving feed conversion rate, and by using cheaper feed. With a single complete diet containing around 3.8% of calcium, limestone, the main source of calcium for a layer diet, represents between 8-10% of the formula. So a lot of 'space' of the diet is taken by limestone, and other raw materials must provide the rest of the nutrients to have a balanced feed.

The higher the proportion of limestone in the diet, the higher the concentration of the other raw materials must be. The morning feed with lower limestone content, allows the use of more cereals or oil seed by-products, decreasing the cost of the feed. The global feed cost per hen is then reduced with split feeding compared to conventional feeding.

Impact on performance

The main advantage of the split feeding technique is to improve the eggshell quality. Bird's metabolism differs according to the period of the day. Providing a different proportion of calcium and phosphorus during the day allows birds' nutrition to be close to requirement. Bone mobilisation is lowered and eggshell qualities improve for the whole production period and especially when birds are old.

When feeds used are well balanced, performance, as laying rate and egg size, are not affected with split feeding. Production costs and FCR are improved and linked to the lower feed consumption observed. However egg producers must pay special attention to birds' bodyweight and flock uniformity, especially at the start of lay. Lower feed intake could lead to lower bodyweight and less robust birds.

As we have seen, split feeding is an excellent technique close to birds' metabolism and optimising nutrient utilisation. To be able to apply this feeding method, the farm must be equipped with extra equipment (silo, timer, switching system). The different feeds must be well designed and balanced to cover the bird's requirement and then to ensure good performances.

It improves production costs by decreasing the daily feed cost. The main advantage is to obtain an excellent eggshell quality and allow birds to lay first quality eggs for a long period. This technique is totally in line with the ISA breeding goal to reach 500 quality eggs per birds at 100 weeks. ■