**Split Feeding For Laying Hens**

The conventional feeding methods for laying hens based on one diet with constant nutrient levels may not result in optimal utilization of all nutrients (Chah, 1972, Leeson and Summers, 1997). When birds are offered diets with the option of self-selection of nutrients, an increase in protein and energy intake in the morning has been observed, around the peak of egg production. Hourly feed intake decreased prior to oviposition, but increased immediately during the time of oviposition. The peak consumption during the evening hours (17:00-19:00) was consistent regardless of the time of oviposition (J.H.Choi 2004). Calcium intake is higher later in the day. A study by Chah (1972), demonstrated that diet with option of self-selection of nutrients, decreased the total daily protein, energy and calcium intake respectively 11%, 8% and 26% lower, compared to hens fed a normal diet.

Commercial laying hens produce the majority of their eggs in the morning (Etches, 1986, Leeson and Summers, 1978, Larbier and Leclercq, 1992). Egg is formed step by step, starts from ovulation and ends by laying egg. Hens will have higher protein and energy requirements during the morning when albumin is started to form and a higher calcium requirement during the evening and night when eggshell formation takes place. Phosphorus is also required mostly during the morning as it is mainly needed to reabsorb calcium to medullary bone.

Nutreco R&D has been working since 2005 to develop a novel feeding program for laying hens according to nutrient requirements for egg formation. Eight trials have been performed between 2005 and 2012. The main objective of these trials was to determine the differential energy, protein, calcium and phosphorus requirements in the morning and afternoon when separate diets are fed. All trials contained a single feed control to corroborate the benefit of the Split feeding system against the current feeding system applied in the egg industry.

Split feeding programs were designed using two diets on the basis of the nutrients required for egg formation phase:

**Morning feed**: 40% of daily amounts with higher energy, protein and phosphorus (lower Ca)

**Afternoon feed**: 60% of daily amount with higher calcium (lower AME, CP and dP)

**Optimization of energy intake**

In this trial, afternoon diet was provided with lower (3% and 5%) energy than the control diet. Single diet (control diet) had same energy level as morning diet. Result showed no effect of reduced energy on performance, feed intake and egg quality. Daily feed intake was not different between treatments. The results confirmed that the daily energy intake was significantly reduced due to lower energy intake during the afternoon (Figure 1 and 2). This energy reduction in the afternoon diet, while maintaining the energy levels as recommended in the morning diet, did not affect performances or egg quality, demonstrating that with split feeding, the energy content in the afternoon diet can be reduced by about 5% compared to the standard single diet recommendation.

**Figure 1**

![Figure 1](image)

**Figure 2**

![Figure 2](image)

**Optimization of protein intake**

Another trial was performed to evaluate the effects of protein reduction in the afternoon diet on performance, feed intake and egg quality. Protein levels were 8% and 17% lower than the single feed (control diet, based on recommendations). In addition, energy level was also reduced in the afternoon diet by 3% compared to the morning diet. Energy and protein levels in the morning diets were same as the control diet.

The results showed that crude protein intake was reduced when the protein content of the afternoon

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diet had been reduced. No difference in performance was observed with 8% protein reduction in afternoon diet and slightly better FCR was also observed. (Figure 3 and 4) When the crude protein was reduced by 17%, a reduction in number of the eggs production was observed with poorer egg mass. Moreover, feed conversion ratio was impaired significantly.

The peak demand of for calcium appears to be in the afternoon (Hughes, 1972.) This was also observed when the reduction in afternoon diet, without affecting performance, eggshell quality and saleable egg production. Phosphorus reduction in the morning diet had a direct impact on nutrient intake, but not on the total daily nutrient intake. Phosphorus level of the afternoon feed can also be reduced by 15%, as no detrimental effect on performance and eggshell quality was observed.

The wide reduction in phosphorus content in the morning diet can be possible due to the fact that calcium level in the morning diet is also reduced considerably in the Split feeding system. As calcium is an antagonist and can bind phosphorus, the lower level of calcium in the gut is translated into more phosphorus available for the animal, and consequently dietary phosphorus requirement is lower in the morning feed.

Split feeding had no negative effect on shell thickness, weight or shell weight per unit of surface area (SWUSA); compared to a single control diet, rather there were some improvements. The split feeding system significantly reduced the percentage of broken and shell-less eggs compared to the control diet which resulted more saleable eggs.

**Split Feeding consistently reduces amount of nutrient loss in excreta**

Results of another trial demonstrated that Split feeding reduces nitrogen, phosphorus and calcium excretion. It could be due to lower daily nutrients intake and a better utilization of those nutrients. The lower nitrogen content in manure might indicate a reduction in ammonia emissions and improved air quality.

**Conclusions and application**

The “Split Feeding System” is an alternative feeding system for feeding layers. It is a tool to adjust the nutrient consumption according to the different requirements throughout the day.

Split Feeding brings an option to supply nutrients at optimal level in order to meet the requirements of hens in the egg formation process. It also opens up the opportunity of more profitable and sustainable egg production, with a lower production cost. By implementing Split Feeding the following benefits can be achieved:

- More profitable egg production, less production cost.
- Improved eggshell quality and increased number of saleable eggs.
- Improved performance and sustainable production.