Effect of housing system on balanced protein requirements in laying hens

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Abstract

It can be argued that the required protein/energy-ratio in diets for floor-housed layers is lower than for hens housed in cages. However, experimental evidence to validate this theory is lacking. Hence, an experiment was conducted to determine the effect of housing system (cage versus floor-housed) on the balanced protein requirements (% of CP in the diet) for egg production in laying hens. The first results of this experiment confirm that for maximum egg production, floor-housed hens require less balanced protein in the diet than caged hens.

Introduction

From 2012 onwards, hens housed in traditional cages will be prohibited in the complete EU; in Germany probably even from 2006 onwards. Alternative housing systems (like aviaries or floor-housed, but also free-range or organic) are quite common already in countries like the UK and The Netherlands, and the number of hens kept in cages decreases rapidly in these countries.

Current nutrient recommendations for laying hens are largely based on research with caged hens. Hens housed in alternative systems, however, have higher feed conversion ratios (FCR) than caged hens. Research indicates that FCR in aviaries is 7-14 points higher than in cages (Van Horne, 1996; Aerni et al., 2005), which agrees well with practical experience in The Netherlands. FCR in alternative systems is higher, particularly because the hens are more active than in cages and, as a result, require more energy for maintenance, which is estimated to be 10% (floor-housed) or 15% (free-range) higher than in cages (Tiller, 2001). In case of bad plumage condition, extra heat loss may result in a further increase in energy requirement for maintenance, depending on the environmental temperature.

Egg production parameters of non-caged layers are usually similar or slightly lower than of caged hens (Van Horne, 1996; Aerni et al., 2005). Hence, it can be hypothesised that the daily requirement for balanced protein (crude protein balanced for amino acid composition) in non-caged hens is not higher than in caged hens. In other words, the required balanced protein/energy-ratio in diets for non-caged layers may be lower than in diets for caged layers. If so, savings in feed cost and reductions in N-excretion could be realised by feeding non-caged layers a diet with less balanced protein than in conventional layer diets, without negative effects on egg production.

To validate this theory, trials are needed in which protein requirements are determined for both caged and non-caged layers in the same environment (same barn), using hens of the same rearing flock. A literature search and a small inventory in Europe delivered no information about such experiments. Therefore, an experiment was started to obtain the required data.

The objective is to test the effects of housing system (cage versus floor-housed) on the balanced protein requirements (% of CP in the diet) for egg production in laying hens.

Materials and Methods

A total of 816 brown laying hens (Bovans Goldline) of 19-35 weeks of age were used. The hens were reared on the floor, received all normal vaccinations and were beak-trimmed at 10 days of age. The hens arrived in the test facilities at 17 weeks of age. Hens were randomly allocated over the experimental units and weighed individually. Based on these individual

weights, one or two hens were exchanged between experimental units in order to obtain similar average hen weights and similar variation in hen weight in all experimental units. During the pre-experimental period of 17-19 weeks of age, all hens were fed the same commercial pre-layer diet.

During the experimental period, four different diets were tested in two different housing systems. Each treatment group was replicated 6 times. Hens were housed in cages or in floor pens, with both housing systems situated in the same barn (17 * 8 m). 216 hens were housed in 24 cages, with 9 hens per cage (19 hens/m2). 600 hens were housed in 24 floor pens, with 25 hens per pen (9 hens/m2). The floor pens included a nest and an elevated area (1.2m2) with a perch. Sand was used as floor substrate in the pens.

Four iso-caloric diets (roller milled coarse meal) with graded levels of CP (13, 14.5, 16, 17.5%) were tested in both housing systems. The ratios between crude protein content and the contents of the essential amino acids (EAA) were similar for all diets (balanced protein). Feed and water were available *ad libitum*. Room temperature and light schedules were according to the recommendations in the management guide for Bovans Goldline.

At two-week intervals, feed intake, hen weight and egg production were recorded per pen or cage. FCR's were calculated from these data.

An exponential dose-response model was fitted to the dose-response data to estimate balanced protein requirements (Eits *et al.*, 2005). Balanced protein requirement was defined here as the dietary balanced protein level (% CP) needed to realise a performance level which is 2% worse than the performance level at the highest balanced protein level in this test (17.5% CP).

Results and Discussion

At the time of preparing this abstract, the experiment was not yet finished. Hence, the results until 28 weeks of age are presented below, whereas the results of the total experiment, including data on egg quality and an economic evaluation, will be presented during the conference. Egg production in the caged layers started two weeks later than in the floor-housed hens, most likely due to difference in light intensity at bird level. Hence, data from 19-22 weeks were excluded from the analyses.



Figure: *Responses of caged and floor-housed laying hens (23-28 weeks of age) to balanced protein level in the diet (% CP).*

The Figure depicts the responses of the laying hens to the balanced protein content of the diet. FCR in floor-housed hens was 10-15 points higher than in caged hens, which agrees well with literature data (Van Horne, 1996; Aerni et al., 2005). In contrast to caged hens, floor-housed hens partly compensated for a lower balanced protein content in the diet by increasing the feed intake.

In both housing systems, decreasing the content of balanced protein in the diet negatively affected egg production (egg mass, egg weight and rate of lay). However, this decline in egg production was less pronounced with floor-housed hens than with caged hens. Hence, the calculated balanced protein requirement for maximum egg production in floor-housed hens was lower than in caged hens (Table). Balanced protein requirement for minimal FCR was similar for both housing systems.

Table: Effect of housing system on balanced protein requirement (% CP in the diet) (SE between brackets) for maximising egg weight (g), rate of lay (%) or egg mass (g/h/d), or minimising feed conversion ratio (FCR) in laving hens (23-28 weeks of age).

Housing	Egg weight	Rate of lay	Egg mass	FCR
Cage	17.0 (0.7)	14.1 (0.8)	16.9 (0.8)	17.2 (0.9)
Floor	15.1 (0.3)	< 13.0	14.2 (0.5)	17.4 (0.6)

The low balanced protein requirement in floor-housed hens, relative to caged hens, agrees with expectations based on the higher activity of hens in non-caged systems compared to hens housed in cages. However, part of the observed effect of housing system on balanced protein requirement may be explained by the fact that the floor-housed hens increased their feed intake at lower balanced protein levels, whereas the caged hens even tended to decrease their feed intake when fed diets low in balanced protein.

Conclusion

The first results of this experiment confirm the hypothesis that balanced protein requirement (% CP in the diet) for maximising egg production in floor-housed laying hens is lower than in caged hens.

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