Self-Selection Feeding For Pullets - Part 2

Figure 2 a: Feed Intake (g/h/d)

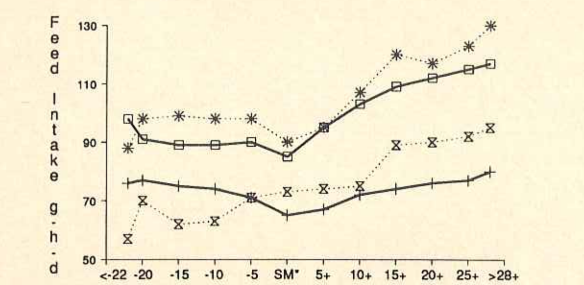


Figure 2 a.b.c.d. Represent the feed intake, protein:energy intake ratio and the egg mass output for pullets relative to their Physiological age of Sexual Maturity (SM)* (unit=days) for complete and self-select diets relative to the environmental temperature (hot vs cold).

Complete Diets		Self-Select Diets
Series 2	Hot 25-35C	Series 1
Series 4	Cold 5-15C	Series 3

*Physiological age of Sexual Maturity (SM) = days +- from first egg

Figure 2 b: Protein Intake (g/h/d)

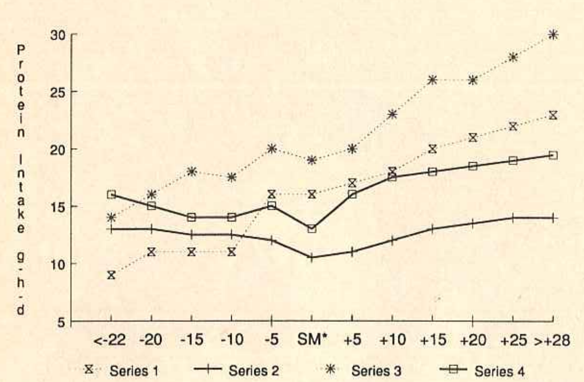
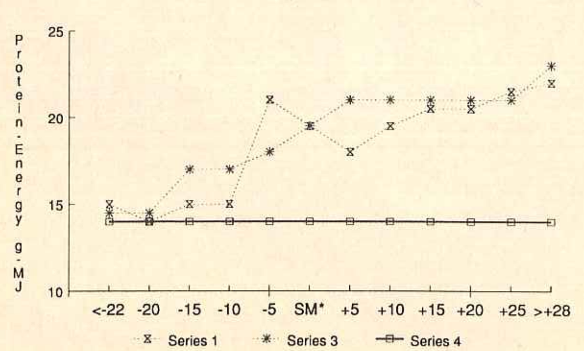


Figure 2 c: Protein:Energy Intake Ratio (g:MJ ME)



Part 1 of this series introduced the topics concerning temperature, self-select feeding and sexual maturity as well as outlining the two experiments conducted. Part 2 discusses the influence that hot and cold temperatures, intermittent lighting and diet regimen (complete vs self-select) have upon feed and nutrient intake and selection, bodyweight change and egg mass output relative to the pullet's status of sexual maturity.

The pullets maintained under hot as compared to cold temperatures consumed significantly less food and nutrients, produced less egg mass and actually lost bodyweight between sexual maturity and 28 weeks of age. However, there were no differences between the protein:ME intake ratio selected by self-select fed pullets under either temperature treatment.

Feed Intake

The change in feed intake relative to the pullet's physiological age of sexual maturity, as presented in Figure 2.a., highlights several interesting features. There was a noticeable drop in feed intake at sexual maturity. The values presented here are means for 12 individual hens/treatment over a five day period surrounding the actual day of sexual maturity. This 'averaging' masks the sharp decline in food intake on the day of first egg particularly noticeable in some individuals.

The other features to note in Figure 2.a. are: as the pullet attains sexual maturity there are differences in feed intake between temperature treatments and diet regimen fed. Pullets fed the complete diets and held under cold temperatures show a significant increase after attaining sexual maturity whereas at the hot temperatures the feed intake remained at a level equal to that consumed 2 to 3 weeks before sexual maturity. In contrast, self-select fed pullets held at both hot and cold temperatures increased food intake after sexual maturity. Pullets under hot temperatures (25 to 35 degrees C) allowed to self-select nutrients consumed 15g more feed/day than pullets fed complete diets.

ME Intake

The ME intake response (not shown in the graphs) were similar to that for feed intake. The high and low energy levels used here did not influence overall feed intake by the pullets. And as a result, a significantly higher ME intake by pullets fed the high energy diets was recorded. Leading to questions on the pullet's ability accurately to adjust their ME intake when fed diets differing in ME level. Although self-select fed pullets consumed more feed (15-20%) than pullets fed complete diets much of this was selected from the low energy protein component. Therefore, the actual ME intake was not increased when pullets were self-select fed.

Protein Intake

A hen fed a complete diet can only increase or decrease the intake of a specific nutrient, for example protein, by changing the intake of all other nutrients to the same degree. A hen allowed to self-select nutrients can, in theory, 'balance' the intake of one nutrient relative to all other nutrients and avoid over consumption of nutrients which are not required. Therefore, protein intake by pullets fed the complete diets under either hot or cold temperatures would form an identical pattern to that of their feed intake, energy intake, calcium intake and so forth (Figure 2.b.). The ratio of protein (g) consumed relative to the energy (MJ of ME) consumed by pullet's fed the complete diet is fixed at approximately 14 g/MJ of ME.

Pullets fed a complete diet and requiring more protein relative to energy would be forced to: (1) consume excessive amounts of energy and store this as body fat; (2) decrease its requirement for protein (ie slow growth or production of eggs) to meet its actual intake of protein; (3) change the retention of the respective nutrients either decreasing the rate of absorbance or increasing the rate of excretion of nutrients not required or visa versa for required nutrients; or (4) supplement its nutrient output by mobilising body reserves. Mobilisation of body reserves could only occur for hens laying eggs. The amount of nutrients mobilised will be limited by a 'physiological' set point beyond which a hen can no longer lose body reserves without compromising its survival. In reality, the hen fed an inflexible nutrient ratio (complete) diet will likely use a combination of these four alternatives when her nutrient ratio requirements do not match that received from the diet.

The self-select fed hen which can alter its intake of specific nutrients, as in the example of the protein and energy self-selection work presented here, will choose the correct amount of nutrients to meet specific nutrient requirements. Therefore, self-select fed pullets would be expected to avoid excessive fat deposition or loss of body stores, minimise metabolic process required to process and/or excrete excess nutrients and maintain a desired growth and/or egg mass output.

It is evident from Figure 2.b., that pullets fed by self-selection consumed significantly greater amounts of protein than pullets fed the complete diets at both hot and cold temperatures. In fact, after sexual maturity the pullets fed by self-selection and maintained at the hot temperatures were consuming more protein than the pullets fed the complete diets at either temperature.

For those concerned with feeding of pullets at hot temperatures it is important to note that the pullets fed by self-selection were able to consume up to 20g protein/day by the third week following sexual maturity whereas pullets fed the complete diets were only consuming 12g of protein/day. Similarly in other experiments pullets held at hot temperatures and fed complete diets containing up to 180g protein, regardless of energy level, were only able to consume 14g protein/day. NRC (1984) estimates daily protein requirement for egg laying hens to be between 16 and 17g/hen/day - regardless of temperature!

Likewise, for those concerned with feeding pullets held under cold temperatures it is important to note that self-select fed pullets were consuming on average 30g protein/day following sexual maturity or nearly double their daily requirement (NRC, 1984). One explanation for this high protein consumption by pullets under cold temperatures is that their appetite for nutrients is

Figure 2 d: Egg Mass Output (g/h/d)

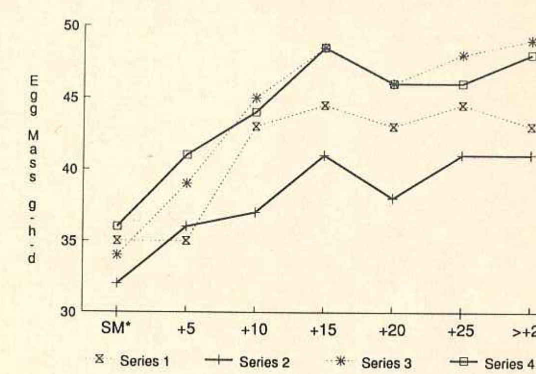


Figure 3 Change in Body Weight (g/h/d) between Sexual Maturity and 28 weeks for complete and self-select diets at hot and cold temperatures.

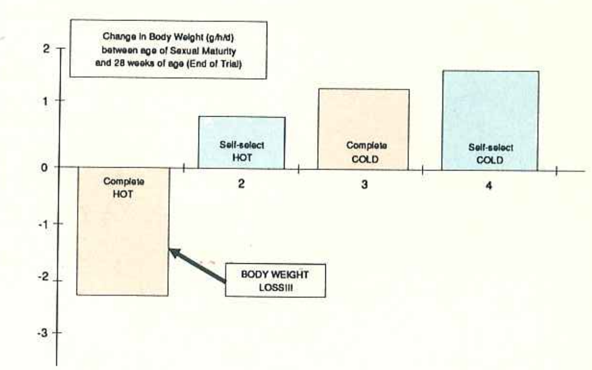


Figure 4 a: Feed Intake (g/h/d)

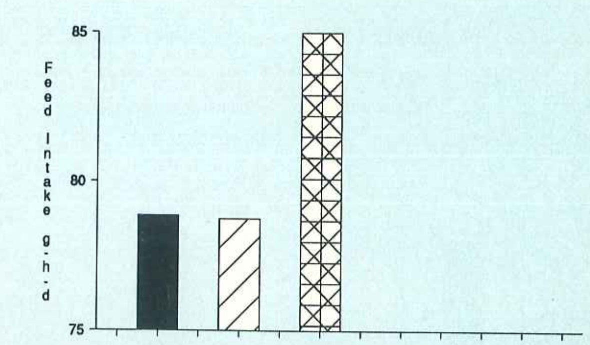


Figure 4 a.b.c.d. Represent the feed and protein intake, protein:energy intake ratio and the egg mass output for pullets relative to the Intermittent Lighting treatments.

LIGHTING PATTERNS
CONTROL TEST 1 TEST 2

controlled not by the single nutrient, but, by a need to maintain a constant ration between specific nutrients.

Protein:Energy Intake Ratio

The optimum ratio between nutrients will change with the physiological needs of the hen. For example, during and after sexual maturity nutrient requirements differ from those needed during growth (Figure 2.c.). During sexual maturity the pullet's protien:energy intake ratio has changed from approximately 14:1 two weeks before sexual maturity to approximately 20:1 at sexual maturity from whence it remained relatively constant. The calculated average protein:energy ratio for the complete diets tested in this study were approximately 14:1.

Figure 4 b: Protein Intake (g/h/d)

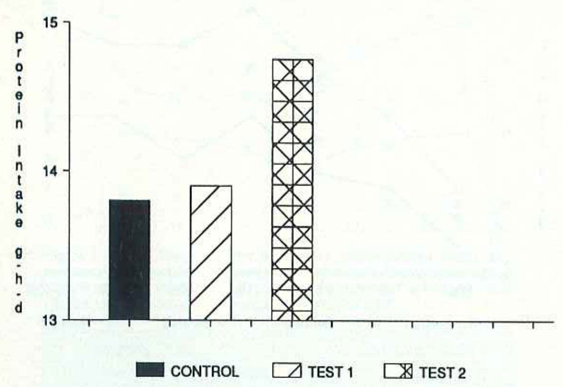


Figure 4 c: Egg Mass Output (g/h/d)

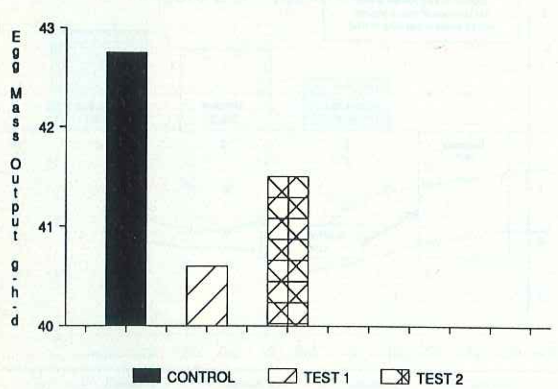
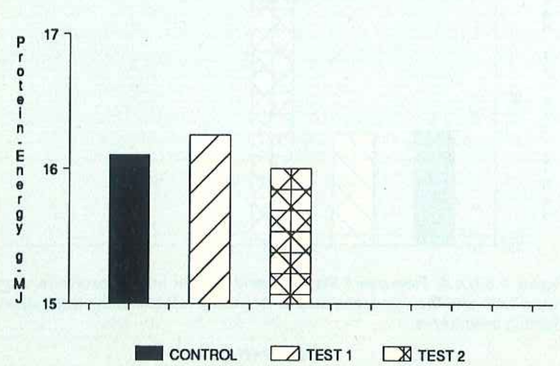


Figure 4 d: Protein:energy Intake Ratio (g/MJ ME)



The protein:energy intake ratio selected by pullets at hot or cold temperatures are similar and change in response to the pullet's physiological change at sexual maturity. It must be remembered that this is the ratio of protein:energy and not the actual nutrient intakes. Even though environmental temperatures were markedly different and as a result so were maintenance energy requirements the self-select fed pullets maintained nearly identical protein:energy intake ratios. In order to maintain the same protein:energy intake ratio after sexual maturity pullets would be consuming proportionally more protein at cold (30 g/d) as compared to hot (19 g/d) temperatures. In other experiments with variations in treatments described here the self-select pullet has consistently maintained the protein:energy intake ratios presented relative to status of sexual maturity.

Egg Mass Output

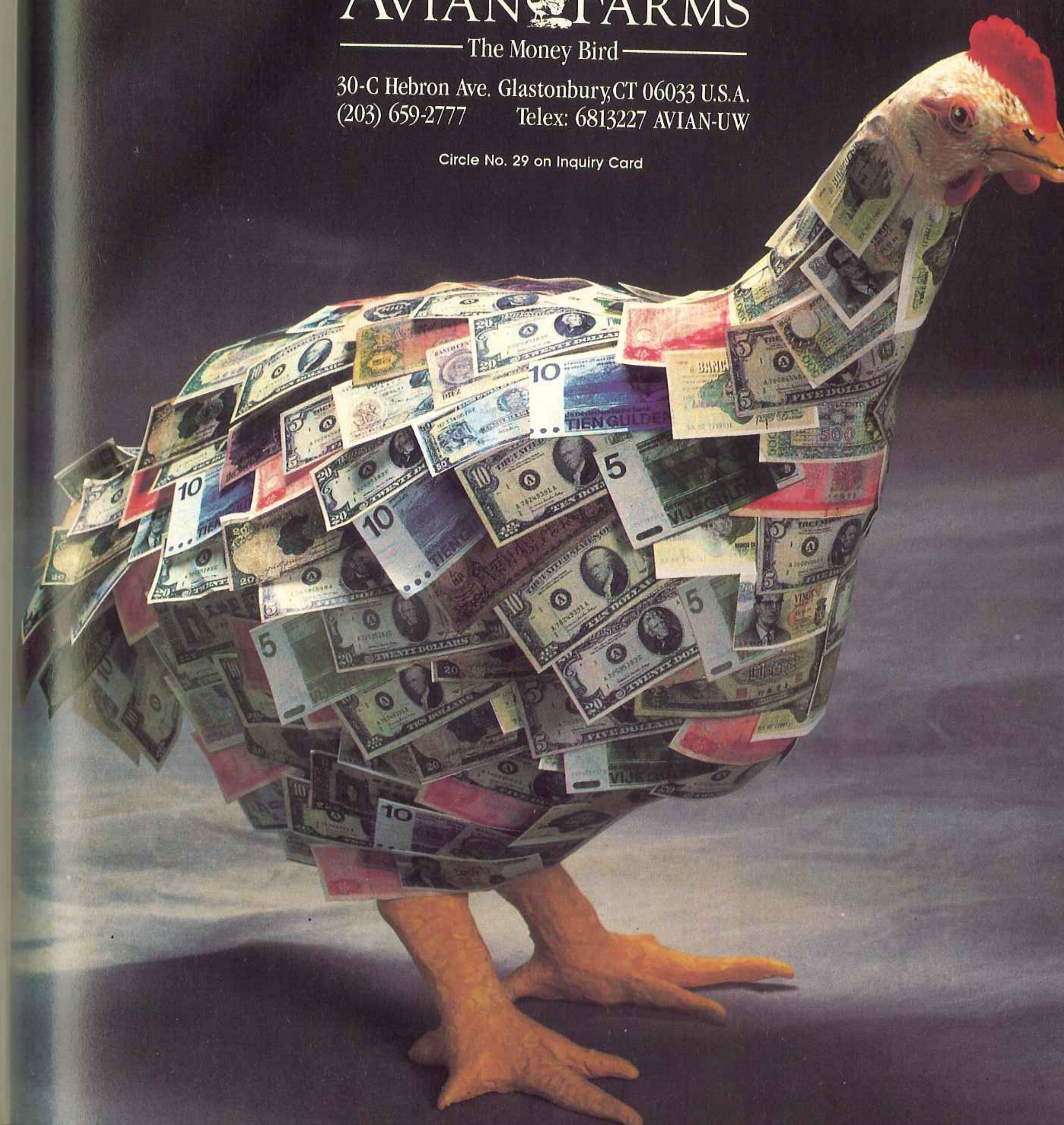
The value of any feeding programme is reflected in the hen's production, body weight/composition changes and ability to maximise nutrient utilisation or retention. How dietary regimen and temperature influenced egg mass output and bodyweight relative to physiological age of sexual maturity are presented in Figures 2.d. and 3. The hen's egg mass output (g/d) is reduced, and the hen's lost bodyweight between sexual maturity and 28 weeks of age (when the experiment was ended) while hens are maintained under high as compared to low temperatures.

Figure 2.d. shows that there were no significant differences in egg mass output at the cold temperatures even though pullets fed by self-selection at this temperature were consuming 30g protein/day. At hot temperatures the pullets fed by self-selection were producing more egg mass/day than pullets fed the complete diet. However, this higher egg mass output was still lower than that of pullets kept at cold temperatures and fed either diet regimen.

Another feature of the egg mass output pattern to note is the short term 'dip' which occurred immediately after the pullets attained peak egg mass output. Similar observations have been reported by other researchers who attributed this to the pullet's inability to acquire sufficient nutrients to sustain peak egg production. The birds were forced to slow production in order to rebuild its depleted nutrient reserves. At peak production the pullet is still gaining bodyweight. Therefore, limitations in food intake for whatever reason would prevent the pullet from sustaining egg mass output. Gut size at sexual maturity may be one factor which may limit the pullet's ability to consume sufficient nutrients to meet the sudden increase in nutrient demands for egg production. Limited food intake at sexual maturity may also be a behavioural response by the pullets which are going through sudden and new hormonal changes.

Bodyweight Change

In Figure 3 the change in bodyweight between sexual maturity (which was similar for all temperature and dietary regimens with a mean of 24 weeks) and 28 weeks



of age was influenced by temperature and dietary regimen. At hot temperatures only pullets fed by self-selection gained bodyweight during this time. Change In bodyweight is only a gross assessment of the pullet's reliance upon specific tissue (fat vs muscle vs bone) reserves during sexual maturation and early lay.

Intermittent Lighting

Intermittent lighting patterns were tested to examine the influence of offering a supplemental amount of light (2h) during the dark (cool) phase of a hot 'day' (Test 1) or the influence of offering the same as above, but giving the birds 2h of darkness during the light (and hottest) phase of the day (Test 2) as compared to a control. In Figure 4.a.b.c.d. the mean for lighting treatments are given for feed and protein intake, protein:energy intake ratio and egg mass output.

Allowing the pullets to have access to feed during the normal dark period (2h light between 2300 to 0100h) when house temperatures were at their lowest (Test 1) had no influence on feed or protein intake as shown in Figures 2.a.b. However, when the pullets were given a similar lighting programme with a 2h dark period when house temperatures were at the highest (1100 to 1300h) consumed significantly more feed (6 g/h/d) and more protein (1 g/h/d) than pullets given the control or Test 1 lighting programme.

The foremost observation is that there was no significant difference in egg mass output between lighting patterns tested under hot temperatures (Figure 4.c.). However, food and nutrient intakes were significantly greater with pullets given 2h of dark at the start of the hottest part of the day as compared to the controls or Test 1 lighting patterns. Since the pullets under Test 2 lighting conditions were consuming more nutrients without changing egg mass output these nutrients were, at least in part, used to increase the bodyweight of the pullet. The pullets under Test 2 lighting had a positive weight gain between sexual maturity and 28 weeks of age as compared to a loss in bodyweight gain between sexual maturity and 28 weeks of age as compared to a loss in bodyweight during the same period by the birds given the control or Test 1 lighting patterns. The other inconsistency in this experiment was that although the pullets fed self-select diets consumed more food and protein they lost more bodyweight than those pullets fed the complete diet. However, these same self-select pullets produced significantly more egg mass output than the pullets fed the complete diet. Further effort in testing intermittent lighting, particularly by offering a dark or quiet period during the hottest part of the day must be examined as a means of managing pullets under hot temperatures. Altering the lighting pattern did not influence the pullet's protein:energy intake ratio (Figure 4.d.).

Conclusions:

1. Pullets allowed to self-select nutrients from a protein concentrate and either a separate complete diet or cereal-based, energy-rich mixture showed preferences for protein and energy which varied in relation to the time of their onset of lay.

2. The selected protein:metabolisable energy (ME) intake ratio increased from 14g protein per MJ of ME 2 to 3 weeks before sexual maturity to approximately 20g protein per MJ of ME at and after sexual maturity. Actual protein intake by pullets at hot and cold temperatures was respectively 19 and 30 g/hen/d by three weeks after laying first egg.

3. This response to self-selection feeding was consistent with different temperatures, lighting patterns and dietary manipulations.

4. Egg mass output was improved by self-selection feeding at hot (25 to 35°C) temperatures. However, no beneficial response in egg mass output from self-selection feeding was observed at cold (5 to 15°C) temperatures.

5. Providing 2h of additional light during the dark (cool) part of the day, with or without 2h of darkness in the middle of the extended light (hot) period, had no effect on the egg mass output of pullets at hot (25 to 35 degrees C) temperatures. —*Tom A. Scott and Derick Balnave, Department of Animal Husbandry, University of Sydney, Werombi Road, Camden, N.S.W. 2570, Australia.*