Self-Selection Feeding For Pullets - Part I.

This two-part series examines the influence of the interaction between diet (specifically how we can manipulate the bird's 'ability' to self-select nutrients), temperature and intermittent lighting upon sexual maturity and early egg production. Part I describes the background to why self-selection feeding was tested and how it was tested with emphasis given to the specific period of sexual maturity and early lay. The results and discussion of these treatments will be presented in Part II.

Temperature Influence

Nutritional-environmental interactions are no misnomer. There would appear to be nearly as many different bird responses as there are possible nutritional and environmental permutations or combinations. This makes it extremely difficult to assess and criticise published results and observations.

Major influences of temperature upon poultry productivity are: (1) via changing feed and/or nutrient intakes which, in turn, influence production and/or production efficiency; and (2) the direct effect of temperature upon production (ie., growth and/or egg mass output). The producer can manipulate the pullets nutrition to prevent some of the losses experienced with high temperatures. However, producers must also consider making changes in housing and management to optimise temperature, humidity and air exchange.

Personal experience in poultry production is derived from two markedly different environments. Canada and Australia. In Canada, poultry house temperatures fluctuate less than 10 degrees C from season to season although the outside temperatures may vary by more than 80 degrees C. This control over house temperature allows feeding of diets formulated for specific intakes practical. On the other hand the Australia with its very temperate environment many houses are typically uninsulated, open-sided and/or saw toothed, exposing the birds to widely varying temperatures. For example, at the Poultry Husbandry Unit in Camden during the spring of 1986 shed temperature fluctuations of 0 to over 40°C were monitored and on occasion daily temperatures fluctuated by over 20°C.

Why Self-Selection Feeding?

This fluctuation in temperature directly influences the bird's requirement for maintenance energy, and thus, results in large variation in feed intake. Formulating a diet to insure adequate (and economical) intake of nutrients, other than energy, under these continually changing conditions is impossible. This was one of the arguments we used when deciding to test the hen's ability to self-select nutrients. Self-select feeding, in theory, would enable the pullets to adjust energy to meet the changes in requirements for maintenance (as environmental temperatures change). While also allowing the pullet to maintain the correct intake of other nutrients required for egg production and/or bodyweight gain.

Other arguments which support the use of self-select feeding include: (1) meeting the diversity in the individual pullets nutrient (energy, protein and calcium) requirement as a flock becomes sexually mature; and (2) to enable the egg producing pullet to meet specific changes in hourly requirements which develop in response to a specific stage of egg formation as for example during shell deposition later in the day.

The pullet grower places great emphasis upon producing a 'Uniform' flock or pullets of equal bodyweight and stage of development at time of housing. However, as a flock reaches sexual maturity the bodyweight variation of individuals within any one strain of birds may be as large as 1kg. Likewise, the age at which pullets achieve sexual maturity (physiological age) can vary by more than 10 weeks. Often, practical feeding conditions (feeding a complete diet with fixed nutrient levels) accentuate non-uniform development of the flock particularly as the flock begins to produce eggs. Pullets which mature early are often consuming a grower diet deficient in nutrients such as calcium and amino acids. While pullets which are late in reaching sexual maturity may be

Figure 1. The Daily Hot and Cold Temperature Cycles and Lighting Patterns (Lights On vs Lights OFF) tested under Hot Environmental Temperatures.

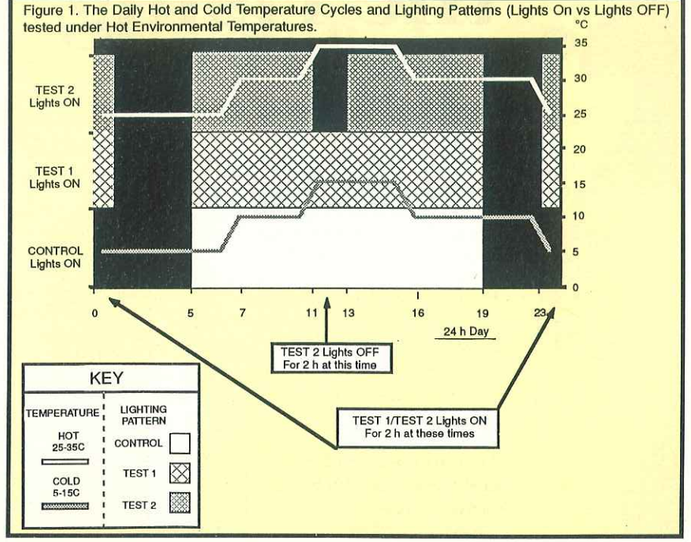
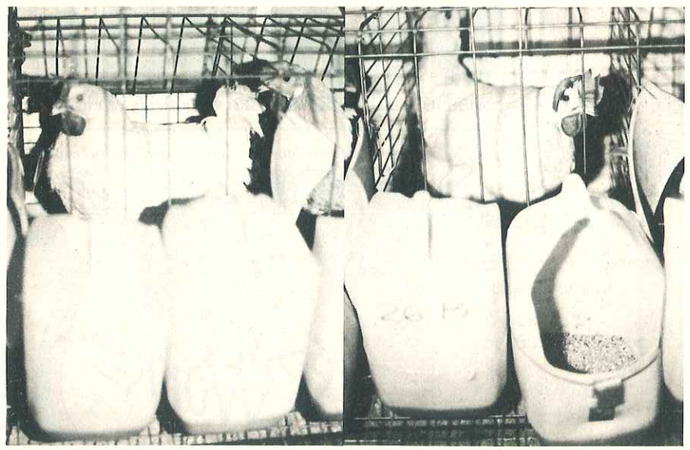


Table 1: Calculated nutrient profile (/kg diet) for complete and self-select egg laying diets

	Complete Layer Diets		Self-Select Layer Diets		
Nutrient Profile	High	Low	High	Low	Protein
ME-MJ	12.0	10.2	12.2	10.3	8.8
Crude Protein-g	150.0	150.0	106.5	107.8	375.7
Lysine-g	12.5	14.7	8.7	10.5	42.7
Methionine-g	6.3	6.3	3.0	3.1	27.0
Calcium-g	35.0	35.0	35.0	35.0	35.0
Available Phosphorus-g	3.8	3.8	3.8	3.8	4.3
Linoleic Acid-g	9.0	9.0	9.3	9.0	9.0
Ether Extract-g	85.0	29.6	82.7	26.5	32.2
Crude Fibre-g	28.3	53.8	21.7	47.2	98.6

(List of references available from the author on request).



Cage and feeder system used for self select pullets.

forced to consume laying rations too high in calcium. Self-select diets would enable all pullets within a flock to meet their individual requirements for these nutrients. Early maturing pullets could then sustain egg production by acquiring higher levels of calcium and other nutrients while late maturing pullets could continue to eat a low calcium diet and 'catch-up'.

In theory, self-select feeding would also enable the hen to adjust 'finely' its-hour-by hour intake of nutrients and avoid consumption of an imbalanced diet with a high heat increment. Intake of a poorly balanced diet yields a rise in metabolic heat production and consequently a rise in body temperature. This is due to heat produced from the metabolism, storage and/or excretion of break-down products from nutrients not required at a specific time. This situation is particularly crucial during periods of high temperatures or when temperatures oscillate rapidly.

Pullets fed a complete diet would not be able to meet hour-by-hour changes in their requirements for specific nutrients without altering the rate of intake of other nutrients present in a complete diet. As an example, there is a characteristic increase in calcium required by the laying pullet during the later part of the day when shell deposition is high. During the summer this coincides with the hottest part of the day, a time when maintenance energy requirements would be lowest. Under these same conditions self-select fed pullets would be able to consume adequate amounts of calcium without over consuming energy and/or protein. Pullets have also shown specific changes in protein intake in response to the stage of egg formation.

What happens at sexual maturity?

Sexual maturity, or age of first egg, is preceded by rapid changes in the pullet's physical size and shape, physiology, endocrinology and behaviour. The ability of a pullet to meet these changes while coping with environmental, social and possibly nutritional stressors makes the onset of sexual maturity one of the most stressful periods in a pullet's productive life-cycle. Therefore, it is crucial that we understand normal development, prior to and following

sexual maturity, and learn to recognise when a pullet is encountering stress which may prevent it from reaching its genetic potential.

The amount of food consumed by the sexually maturing pullet is of great importance. Apart from the nutrients required for maintenance, at sexual maturity, there are large increases in nutrients required for rapid growth, the development of the oviduct and ovaries and the actual production of egg components as the pullet attains sexual maturity. Johnson et al (1984) reported that pullets will gain 400g during the two weeks prior to sexual maturity. Furthermore, within days of attaining sexual maturity the pullet must meet the nutrient requirements of a daily egg mass output of over 50g/hen/day.

The changes at sexual maturity increase the pullet's requirement for all nutrients. However, the changes in requirement for specific nutrients may not necessarily change in the same ratio as was required by the pullet during its growing stage. Earlier researchers reported, that an egg-laying hen required 3.0g protein/d for maintenance, 1.4g for growth, 0.4g for feather growth and 12.2g for egg production to give a total of 17g/hen/d. The daily protein required for egg production is equal to 72% of the daily protein intake. Similarly for energy, a 1.8kg hen maintained at 20 degrees C and laying 50g egg mass/d would require 1.3 MJ of ME, of this 0.43 MJ or 33% of the daily energy required would be used for egg mass output. It is obvious that, as the pullet reaches sexual maturity its need for specific nutrients, such as protein, are comparatively greater than its need for energy.

Furthermore, should the house temperature change from 20 to 35 degrees C daily energy requirements would drop from 1.3 to 1.1 MJ ME/d. This 15% decrease in maintenance energy requirements which would signal a 15% decrease in food intake. Yet, if all other variables (including level of production) remained constant the pullet would still require 17g protein/d. When pullets are fed a complete diet the ratio of nutrients are fixed and the pullet would be consuming 15% less protein in response to the decrease in food intake at the higher temperatures. While the self-select fed hen would decrease its intake of energy at the higher temperatures and still maintain its intake of protein by selecting less of the high energy/low protein diet and more of the high protein/low energy diet.

In the development of the present commercial strains of egg laying hens we have taken the level of production a long way from what was demanded of the bird in its original state. Wild birds normally only have a short 'sexually active period' during which they lay one clutch of eggs. Studies of egg production of wild Mallard ducks showed that during the production of a clutch of eggs there was a significant reduction in body lipid stores. If the first clutch of eggs were destroyed the second clutch of eggs would usually be smaller and actual numbers laid in the second clutch determined by the duck's remaining lipid stores.

Evolutionarily speaking this link between body stores and number of eggs laid would act as a natural 'check and balance' keeping numbers of offspring low when insufficient

nutrients are available to allow sufficient lipid storage in the female. With this 'theory' in mind we question the practice of restricting feed to the small bodied laying hen during the later part of its growing period. In fact, to encourage higher egg production it may be necessary to develop ways to stimulate intake prior to sexual maturity. Such as, develop feeding practices to encourage lipid store development or to insure the bird's 'gut' is large enough to handle the sudden increase in food necessary to supply the bird's requirements at sexual maturity and beyond.

The literature alludes to the importance of bodyweight as a buffer during times of nutritional stress such as, for example, peak egg production. However, the limits to the pullet's ability to maintain egg production at the expense of bodyweight are not well documented. Nor are some of the anomalies which occur in pullet behaviour at sexual maturity such as the drop in feed intake and the pullet's ability or inability to meet requirements from self-select feeding regimens currently available.

To the author's knowledge there have been no detailed studies on the use of self-select feeding of energy and protein 'rich' diet components at the time pullets are attaining sexual maturity. To equate pullet performance relative to sexual maturity requires that extensive records of individual pullet egg production and feed intake be made and these values related to the pullets physiological age rather than its chronological age. By this method we have examined how temperature and lighting influence the pullet's feed intake and how feed intake, in turn, influences nutrient intake and retention, egg production and bodyweight during the crucial period of sexual maturity and early egg production.

Experimental Design

Pullets used in these experiments were commercial Australorp and White Leghorn crosses. Pullets were reared in groups to 14 weeks of age and then caged individually and introduced to their respective dietary treatments. The temperature treatments were started at 16 weeks of age and all daily records of food intake and egg production were begun at 18 weeks of age. Food intake and egg production data were summarised relative to the pullets physiological age rather than its chronological age of sexual maturity. That is, individual pullet records for feed intake and egg production were compared relative to time before and after sexual maturity rather than to the actual age of the pullet. The experiments were terminated at 28 weeks of age. Food and water were provided ad libitum, a photograph of the cage and feeder system used for self-select feeding the pullets is shown below.

The results from two experiments will be highlighted in Part 2, next month. In one experiment we examined the influence of cyclical hot (25-35 degrees C) and cold (5 to 15 degrees C) temperatures upon pullet performance. While in the second experiment the influence of alternate

lighting programmes at cyclical hot temperatures were tested. A description of the daily hot and cold temperature cycles and the intermittent lighting patterns tested are presented in Figure 1. (See figure 1 on page 38).

The control lighting pattern had lights on at 05:00 h and lights off at 19:00 h to give a total day length of 15 h. Test 1 lighting pattern had an identical pattern as the control with a further 2 h of supplementary light being given during the control dark period between 23:00 and 01:00 h, this coincided with the beginning of the coolest (25 degrees C) part of the temperature cycle. A total of 17 h light were given in Test 1. Test 2 lighting pattern was identical to that of Test 1 except that beginning at 11:00 a 2 h lights off period was provided, this 2 h lights off period coincides with the beginning of the hottest (35 degrees C) cycle of the day. A total of 15 h light were given in Test 2.

Two complete diets were tested in each experiment. They varied in energy (low vs high) all other nutrients (crude protein, calcium, phosphorus and linoleic acid) remained constant. Two self-select regimens were tested. The first was based on feeding an energy (cereal based diet high in energy and low in protein) and a protein (protein supplement based diet low in energy and high in protein) component (both balanced for minerals and vitamins) in separate feeders. The second self-select feeding regimen involved feeding a complete diet (identical to the complete diet described above) in one feeder complemented by the protein component in a second feeder. In one trial a third feeder containing a high calcium (ground limestone 1:1 with a complete diet) was offered. However, the pullets found this calcium component to be either unpalatable or not required since no consumption during the study period was recorded. The calculated nutrient composition of test diets are presented in Table 1 (See table 1 on page 38).—*Tom A. Scott and Derick Balnave, Department of Animal Husbandry, University of Sydney, Werombi Road, Camden, N.S.W. 2570, Australia.*

Biosecurity in a Small Island State

Biosecurity is the concept of preventing the entry of disease-causing organisms (pathogens) into a designated area or population of animals. The concept is taken to its ultimate in the production of specific pathogen free poultry for experimental purposes. However, the concept can also be applied to those farms which seek to put in place as many measures as are practicable to prevent the entry of foreign pathogens to their livestock.

The concept can also be applied to sovereign states which attempt to protect their local livestock industry from potentially devastating diseases not presently found within their borders.

Land-locked countries often find it impossible to eradicate disease and maintain the country free of these diseases. The presence of large areas of wilderness either within or outside territorial borders often allows disease to be harboured in wild mammals and birds. These wildlife reservoirs of disease usually defy all attempts at absolute control.

Continental countries therefore, are often forced to accept the presence of economically significant diseases in their animal population which might in other circumstances be amenable to eradication. For example, Newcastle Disease virus in poultry and rabies virus in mammals, are both endemic in various parts of the USA. In contrast the United Kingdom, an island state, has successfully been able to maintain its animal population free from both these diseases for considerable periods of time.

A small island state surrounded by a barrier of water theoretically has a distinct advantage in biosecurity. The sea acts as a barrier to the immigration of most land-dwelling animals. This effectively isolates the island from a major source of exotic diseases. In addition, the small size of the island often means that there is no vast expanse of wilderness inaccessable or unexplored by man. Control of wildlife is therefore often more practicable, although it is still likely to be problematic.

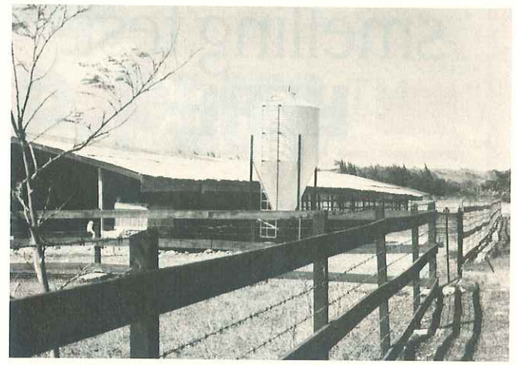
However, migrating birds are a potentially important loophole in an island's biosecurity. These birds travel large distances over water between land masses. They have been suspected as carriers of many exotic avian diseases including Newcastle Disease and Avian Influenza. Depending on the expanse of water between the island and the nearest land mass, and the migratory patterns of any birds passing the area, this may or may not pose a significant disease threat to the local animal population.

For the small island state, therefore, practical measures for controlling the introduction of exotic diseases can be effectively centred on the air and seaports.

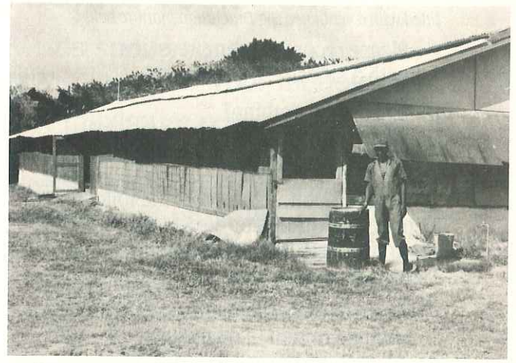
Methods of entry of exotic diseases

1. Human traffic

Human traffic to and from the island is inevitable. This is especially so in small island states which tend to have thriving tourist industries. Fortunately, the general tourist traffic would not be expected to come into habitual contact with local livestock farms and only a small proportion of tourists would have direct contact with



Fencing and lockable gates help in farm biosecurity.



The wearing of overalls and boots and the presence of a footbath indicate an awareness of biosecurity.

The staff of the Veterinary Diagnostic Laboratory, Ministry of Agriculture, Barbados. Left to right: Mrs Pamela Whitehall, Miss Annette Campbell, Mr Ian Browne, Dr Stephen St John, Mrs June Roach.