THE DEVELOPMENT OF THE PRE-LAYING PULLE AND YOUNG HEN

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The change-over from a flock of pullets to a flock of' layers appears to be a very gradual process, taking anywhere from 6 to 9 weeks from first egg to 90% production, an increase of slightly more than 10% per week. However, this is merely the appearance on a flock basis, whereas in reality the individual bird reaches 50% production 3-4 days after laying its first egg and peak production after 8-9 days.

With modern well-bred breeds and strains of layers there is no such thing as 20% or 40% production at the beginning of the laying year, A flock average of 40% production means in reality that about one half of the flock is laying at peak production (90% - 100%) while the other half is not producing at all. In other words, the well-known "gradual" increase in flock production is actually the result of a gradual change in the ratio between non-layers and layers (Nijveld 1968). Accordingly, any time during the first 8 weeks after the first egg is laid, the flock is made up of 3 types of birds (Hurwitz and Bar 1971):

a) Completely immature pullets;
b) Pullets in the 3-week transitional "pre-laying" period of awakening gonadal activity;
c) Hens at peak of production (90% - 100%).

A 100% production of the relatively small early eggs of 55 g, involves a daily loss of 6.6 g protein, 5.5 g fat and 2.3 g calcium (slide 1). Even when fed a very adequate diet, insufficient feed intake and underdeveloped digestive and/or metabolic processes prevent the young hen from obtaining from her diet these amounts of protein, energy and calcium, and as a result she is in a "negative balance" with regard to these nutrients, This occurs in spite of the dual action of oestrogens in mobilizing skeletal calcium and adipose tissue lipids, For example the carrying capacity of the blood for total lipids increases from about 500 mg/100 ml in pullets to approximately 1500 mg/100 ml in layers, and for calcium from 10-12 mg % to 22-28 mg %, respectively (Sturkie 1965).

Thus about 14-16 days (Hurwitz 1964) before laying her first egg the calcium retention of the pullet is greatly increased, apparently due to the appearance of the "medullary" bone in the marrow cavities of the skeleton during this "pre-laying" period (Simkiss 1961). This "medullary" bone, together with the ends of the long bones (Hurwitz 1967), form the storage sites of reserve calcium,, The ability of the hen to withstand the challenge of calcium deprivation is a function of the size of the calcium stores(Hurwitz and Bar 1969), and the size of these pre-laying stores can indeed be manipulated by dietary calcium levels (Hurwitz 1969), as described in slide 2. However, even 4.1% calcium in the diet beginning with 3 weeks before onset of egg production could not completely prevent some calcium depletion associated with early egg laying, in agreement with previous observations (Hurwitz and Griminger 1960).

As a result of the spread in the onset of egg production of close to two months among individual birds of any single flock, the definition of the "pre-laying" period on a flock basis is impossible. In order to overcome this difficulty our series of experiments (Hurwitz and Bar 1971; Hurwitz et al.1971) had to be based on methods developed by Berg et al. (1947).

As mentioned before, the "gradual" increase in flock egg production over a period of about 2 months is misleading physiologically. In most cases the individual bird reaches in about 7-8 days the maximum production of which it is capable, and this is then maintained (Hurwitz et al.1971).

Based on flock averages, the common observation is that egg weights increase markedly during the first 3-4 months of production, with a much slower change during the remainder of the laying year (unless this trend is modified by periods of hot weather), However, on an individual bird basis (slide 3) egg weight increases rapidly for the first 15-20 eggs (20-25 days after first egg), and then approaches a maximum value at a rather slow rate (Hurwitz and Bar 1971). The evolvement of egg shell density (mg/cm^2)follows a similar but steeper curve (slide 4).

On the basis of flock averages, body weights of young laying birds increase relatively rapidly at the beginning of egg production, with a diminishing weight gain after 2-3 months. However, results of two experiments (Hurwitz and Bar 1971; Hurwitz et al.1971), based on individual birds of uniform physiological age, indicate that the birds gain weight during the "pre-laying" period and first few days after first egg at a rate approximately 5 times greater than during the following month, during which the young layer puts on weight at a rate typical of more mature hens.

Feed consumption shows the most unexpected development (Hurwitz et al.1971), as demonstrated in slide 5, including a sharp drop in feed intake four days before the first egg is laid, in agreement with previous descriptions (Foster 1968; Meyers et a1.1970). It appears, therefore, that it requires about one month after having laid her first egg for an individual hen to reach full feed consumption, but only about 1½ weeks to reach peak production.

The above unexplained drop in feed intake just before start of egg production was encountered again in mature hens in connection with the resumption of egg production, which had been interrupted completely by means of nicarbazin (Hurwitz et.al.19'75). The first two weeks after re-start of lay were accompanied by a decided reduction in body weight, indicating a negative energy balance. Egg size and shell density after return to production of force-molted mature hens, behaved not unlike what has been described before for the young laying hen at the onset of production.

Negative protein, energy, and calcium balances, appear to be the rule both at the start of egg production in young hens and at the resumption of production after an induced rest in mature layers, as a result of insufficient feed intake at that stage. Data obtained with relatively large flocks more than 10 years ago (Bornstein 1970) substantiate the low feed consumption at the start of lay (Table 1). The difference between feed intake during the first month of production and that of the 3rd to 5th month of lay was probably even greater than indicated in Table 1, since the first month of each experiment wns in reality the second month of production.

TABLE 1. The daily feed consumption of 4 flocks during their 2nd versus 4th and 5th month of egg production (Bornstein 1970)

Breed/Cross Housing	WL x NH* Floor	NH x WL Cage	WL Cage	WL Cage
Start of experiment	22.10.64	17.11.66	2.11.65	15.12.6
Product. during 1st** month(%)	50	70	75	60
Feed int. during 1st** month				
g/hen/day	96***	107	96	98
kcal/hen/day	267***	302	268	272
Feed int. Jan.-March****				
g/hen/day	120	121	111	109
kcal/hen/day	336	340	310	304

*W.Leghorn x New Hampshire.

**The first month of the experiment was in reality the second month of lay, as seen by the rate of production, with a peak of 80-85% during the third month of laying.

***This experiment was the earliest to start and therefore had the lowest production level (25% rather than 40-60%) compared to the stock on the other trials; hence their relatively low feed consumption.

****3rd to 5th month of lay (4th to 6th month in the first experiment).

These differences in calorie or feed intake (Table 1) cannot be explained on the basis of climatic changes. They are due partly to differential rates of egg production, but are mostly the result of inadequate feed consumption of young layers during their first month of production (on an individual basis).

It appears, therefore, that a specially concentrated "Starter-layer" diet is called for, parallel to the "pre-starter diets in broilers,, Once full feed consumption has been reached - about one month after first egg on an individual bird basis, or about 3 months after onset of egg production on a flock basis (unless hot weather interfers with this development) - there is no justification for continuing this special (and more expensive) "starter-layer" ration, and a change can and should be made to a "regular" layer ration, as advocated for "phase-feeding" (Bornstein 1970).

Slides 6-8 present provisional and incomplete summaries of data obtained in a recent experiment designed to test the use of such a "starter-layer" ration, compared to a diet calculated to just meet minimum requirements for peak production (at about 9 months of age), and to a good practical ration incorporating rather generous margins of safety. Ten weeks after the onset of egg production the "starter" was changed to the "calculated" diet, According to slide 6, the "starter" improved egg production above that of the "calculated" diet during the 4-10 week laying period and during the first month after the change of diet, Egg size (a more sensitive criterion of amino acid adequacy) was improved during the 2-10 week period, but there was no carry-over of this advantage after the dietary change. Note that rates of production of 91% and 93% were obtained with the "starter" and control diets. respectively, at a feed intake of 108 g/day, although full feed consumption was 115 g/day (slide 7). A difference of 6 g in daily feed intake is equivalent to a change of 1 percentage unit in the protein concentration of the feed.

The above advantage in rate of lay and egg size was obtained without a change in daily feed consumption (slide 7), although when considered together as egg mass (g/hen/day), it represents a rather marked difference in performance (slide 8). Accordingly, feed efficiency, expressed as g feed/g egg, was decidedly in favor of the "starter-layer" diet up to the dietary change at 10 weeks after onset of lay, The advantages of this special diet were only temporary, and lasted for no longer than one month after the change to the marginal calculated diet, Conversely, feeding the latter from point of lay, although not as good as the "starter" diet over the "critical" period of 4-14 weeks, had no adverse carry-over effect, The practical diet gave virtually identical results with the "starter", hence was adequate for this, "critical" period, Its use subsequently, however, was wasteful in its protein content.

In a field trial by a feed manufacturer, a special "starter-layer" was compared with the regular (supposedly good and satisfactory) commercial layer ration, both with young Leghorn and crossbred (Leghorn x RIR) hens (slide 9). Obviously the heavier crossbreds ate more, and were able, therefore, to obtain the nutrients otherwise marginal during the critical period, For them the only advantage of the "starter" over the "regular" layer ration was lower feed intake and hence a better feed utilization, since with the latter ration there was a noticeable "compensatory increase" in feed consumption, on top of the relatively high "normal" feed intake of crossbreds. With the Leghorn hens the advantage of the "starter" is pronounced, probably also involving egg size (not determined), resulting in a clear-cut economic advantage,

SUMMARY

A re-evaluation of the dietary requirements at the onset of egg production is proposed, since 3 populations of existing birds should be considered separately:

(a) The immature pullets - having low nutritional requirements (mainly for maintenance);

(b) The "pre-laying" birds - with their decidedly higher' requirements (weight gain and the formation of calcium storage sites);

(c) The laying hens - high requirements (peak production and rapid increase in egg weight, in addition to maintenance and some growth).

Accordingly rational diet formulation must take into consideration the above points, while remembering that:

(a) A ration with layer-type calcium level should start (at the latest) with the appearance of the very first egg;

(b) The flock may lay at a rate of less than 50%, but at that stage more than half of the birds have reached a production of 90 - 100%;

(c) In spite of a production approaching 100% in individual birds, as early as 10 days after laying their first egg, all young hens in lay for less than one month have not yet reached full feed consumption.

Rising feed prices compel feed manufacturers to decrease margins of safety in their formulations, and since modern Leghorn strains have a naturally low feed consumption, both factors combined make it a necessity to follow the recommendation of closely modelling poultry rations to the specific circumstances prevailing and the period in question.

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