Effect of Photoperiods on Feed Intake Rhythms of Domestic Fowl

by

P. D. Ballard * and H. V. Biellier

ABSTRACT. - Pinealectomized and control groups of Single Comb White Leghorn pullets were housed in individual laying cages within an experimental room maintained at a temperature of 22 ± 2°C. Hourly feed intake data were collected on the birds subjected to single 3-h changes in the duration of light or dark periods at either auroral (lights-on) or vespertine (lights-off) time of a 14L:10D lighting cycle. Feed intake reached an acrophase at either the 12th or 13th hour of the light period then declined until the onset of darkness. Vespertine changes in the light cycle were more effective in shifting the intake acrophase than the auroral changes. This observation was consistent irrespective of the direction of the change. When the laying hens were subjected to a 26-h lighting rhythm, the strength of cyclic light as a zeitgeber for feed intake rhythm was again demonstrated. The feed intake rhythm developed a 26-h duration with an acrophase consistently 22-23 hours post-vespertine. Pinealecrtomy did not effect the ability of hens to adjust to new lighting regimens.

INTRODUCTION

The objectives of this research were to characterize the feed intake rhythms of the domestic hen and to identify the possible external environmental cues which synchronize the intake rhythm with the bird's environment.

The eyes are the most obvious candidates for the role of receptor for any potential light zeitgeber, however, Benoit (1964) and Benoit and Assenmacher (1959) have demonstrated the presence of extra-retinal photoreceptors in ducks which affect gonadal development. Blinding does not alter the rate of photo-induced testicular development in the house sparrow suggesting that the eye is not involved in photoreception (Gaston and Menaker, 1968; Menaker, 1968 and 1971; Menaker and Keatts, 1968; Menaker et al., 1970). The pineal gland may be important in regulating circadian rhythm since pinealecrtomy in the house sparrow results in the loss of the circadian rhythm of locomotor activity in constant darkness (Gaston and Menaker, 1968). However, the removal of the pineal had no effect on testicular growth or maintenance in the coturnix quail (Homma, McFarland and Wilson, 1967) or the house sparrow (Menaker et al., 1970). Ralph and Dawson (1968) were unable to demonstrate electrical response to light by the pineal in the house sparrow or the coturnix quail.

The diurnal lighting rhythm has been shown to be a potent zeitgeber in many species and there have been reports that suggest it may act as a zeitgeber for feed intake in the domestic hen. Siegel and Guhl (1956) reported that chicken
laying hens were more often at the feeders and waterers just before the mid-light period. The feeding activity of chicks at 4–8 weeks of age was highest during the first four and the last four hours of the light period (Siegel, Beane and Kramer, 1962). However, they found that birds subjected to constant light displayed no specific feeding activity pattern.

This research was designed to first identify the intake rhythm of the domestic hen and factors which influence the rhythm; then to investigate the way various lighting regimens influence the intake rhythm of control and pinealectomized hens.

METHODS AND MATERIALS

The experimental room (4.5 x 4.5 m) was cooled and heated by a central mechanical refrigeration system capable of maintaining room temperature ± 2°C of the temperature setting used in the experiments. Incandescent lighting was controlled by a 24-h clock and light intensities were 37–65 lux at cage level as measured with a Weston light meter (Model 614).

The room was equipped with 30 individual hen cages arranged in two parallel rows of 15 cages mounted back to back.

The measurement system for feed consumption consisted of the manual alternation of two identical sets of feeders available to the birds. These feeders were square, translucent, polyethylene milk containers of one gallon capacity. An opening shaped like an inverted isosceles triangle with round corners and dimensions of 7.6 cm wide at the top and 10.2 cm high was cut in the side of each container. These feeders were filled to a total weight of 600 g including a 10.5 cm square of 2.5 cm x 5 cm welded wire used as a feed-conserving grid. The layer ration used was the regular University of Missouri layer ration containing 17% regular protein. While one set of feeders was hanging on the cages before the hens, the other set was available for weighing or refilling. This system kept feed available to the birds except for the fraction of a minute required to switch each pair of feeders. The switching of all 30 feeders required two to five minutes.

The feeders were switched at the beginning of the light period and at the end of each successive hour of the light period. The consumption during the dark period and for each hour of the light period was obtained by subtracting the weight of the feeder at the time of switch from its previous weight. Only when one of the feeders weighed less than 300 g were all feeders refilled to a total weight of 600 g. Any feeders with wet feed due to bird regurgitation were emptied and refilled to a total of 600 g and data for that hour were omitted. In addition a check of the litter beneath the cage was made regularly to determine if feed wastage was occurring.

The timing of oviposition was determined by recording and removing eggs each hour of the light period when the room was entered for feed consumption determinations. Each hen was provided an individual Hart watering cup. (H.W. Hart Co., Glendale, California)

ROLE OF DAILY PHOTOPERIOD AS A ZEITGEBER FOR FEED INTAKE RHYTHMS

The first experimental approach was to study the effect of slight changes in the lighting regimen on the feed intake cycle. In addition, the effects of pinealectomy on the time required for adjustment to lighting regimen changes were investigated.

For this experiment 50 day-old female Single Comb White Leghorn chicks were raised to maturity in commercial-type grower batteries. At 4 to 6 weeks of age a group of the chicks was surgically pinealectomized following the procedure described by Homma, McFarland and Wilson (1967). At 6 months of age, 10 of