

Factors Affecting Egg Production in Broiler Breeders from Start to Peak of Production

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Abstract: A study was conducted to determine the effect of environment, nutrition and management on egg production of broiler breeders from start to peak of production. Rearing and production records of 11 Arian broiler breeder flocks, in 3 farms between 1993 and 2000, including age of broiler breeder, age of maturity, flock number, farm number, density, feeder space/hen, body weight at 20, 22 and 24 weeks, protein and energy intake/day and week, cumulative feed intake in each age, weekly body weight, season effect, diet energy and presence or lack of canal under waterers were used. All records processed in excel software and transferred to JMP 3.1.2 software for analysis. Records tested for normality and then analyzed with multiple regression analysis procedure. The results of the current study indicated that, age of broiler breeders has a dramatic effect on egg production. By delaying age of maturity after 24 weeks, uniformity and egg production in Arian broiler breeders increased. Canals under waterer in some of the farms had a negative effect on mean egg production (63 vs 52%). In the seasons of spring and autumn, mean egg production was higher than those of summer and winter (80.03, 81.08, 50.16 and 60%, respectively). The result showed that body weight at 24 weeks is a better indication of subsequent flock performance than body weight at 20 or 22 weeks. By increasing age and protein intake from 23 to 27 g/hen/day, egg production decreased. Conversely, by increasing age and energy intake, egg production increased. Under the conditions of this study, it was concluded that protein intake should not be increased from 23g/hen/day at this period. Heavier broiler breeders, who get more energy intake/day, may produce more eggs too.

Key words: Broiler breeder, egg production, environment, management, peak, nutrition

INTRODUCTION

The goals of the brooding and grow-out systems are to provide pullets and roosters of ideal weight, condition and stage of sexual maturity as they enter the breeder facilities (Leeson and Summers, 2000). Age and body weight are primary factors that influence egg weight of broiler breeders (Yuan *et al.*, 1994). Protein requirement over the entire production period of broiler breeders receive a corn-soybean meal diet without supplemental amino acids is approximately 20-22 g day⁻¹ (Waldroup *et al.*, 1976). Since the hen preferentially partition nutrients to meet the requirement for maintenance, if feed allowance is not sufficient to meet her total energy requirement, egg production and egg size will be reduced (Pearson and Herron, 1982). It is shown that the best performance of broiler breeder is obtained when egg production start from 24 weeks of age

(Leeson and Summers, 2000). To attain optimum body weight in broiler breeders, feed restriction is practiced during the rearing and breeding period. Indeed broiler breeder body weight is highly dependent on feeding program. Lower body weight in broiler breeders during rearing period may delay age of maturity. Total egg production of lighter broiler breeders at 22 weeks compare to moderate or heavier body weights is less studied (McDaniel, 1995). When nitrogen balance in the body is positive, the best performance of egg production in broiler breeders will occur especially in peak period. This is a fact that heavier broiler breeders (a little upper standard) will support production, because these birds can supply enough energy requirements for egg production (North, 1978). It is shown that egg production trend is highly related to energy consumption. The significance of this phenomenon from start to peak of production was also seen (Burke and Jensen, 1994). As

age and egg production toward the peak production increase, protein and amino acid requirement of broiler breeders increase. Inappropriate feeding program brings peak production sooner than expected. So, maximum feed allocation would be at this period and special attention is needed (Leeson and Summers, 1988). It is shown that body weight at 24 weeks of age is better indicator of subsequent flock performance than that of body weight at 20 weeks (Petite *et al.*, 1982). It is reported that protein requirement of broiler breeders with corn and soybean base diet without amino acid supplements, is around 20-22 g day⁻¹ during egg production period (Spratt and Lessons, 1987). Therefore the objective of this study, was to evaluate the available environmental, nutritional and management factors involved in egg production of broiler breeders from start to peak of production.

MATERIALS AND METHODS

In this study, rearing and production records of 11 Arian broiler breeder flocks, in 3 farms between 1993 and 2000 in semi arid area of Birjand, Iran was evaluated. Age of maturity, flock number, farm number, density, feeder space/hen, body weight at 20, 22 and 24 weeks, protein and energy intake/day and week, cumulative feed intake in each age, weekly body weight, season effect, diet energy and presence or lack of canal under waterers were used. Ranges of some records are reflected in Table 1. The effect of management was similar among all farms. Daily records changed to weekly and after processing in Excel software, transferred to JMP 3.1.2 (SAS, 1989) for analysis. Records tested for normality by Shapiro-Wilk W test and then analyzed with multiple regression method under least square and stepwise procedures (SAS, 1989). The following model was used to estimate parameters:

$$\hat{Y} = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_n X_n + \epsilon$$

In this model Y is estimation of egg production, β is regression coefficient of independent variables, X is independent variable or interaction between two variables and ϵ is residual effect.

Table 1: Ranges of some independent variables recorded in 11 Arian broiler breeder flocks, in 3 farms between year 1993-2000

Variables	Minimum	Maximum
Feeder space/hen (from week 19)	14.00 cm	28.00 cm
Density, bird/m ² (from week 19)	4.20	7.54
Diet energy (kcal kg ⁻¹)	2550.00	2879.00
Diet protein (%)	14.00	18.00
Egg production (%)	1.00	90.00
Refused eggs (%)	2.00	100.00
Mortality (%)	0.00	6.78

RESULTS AND DISCUSSION

Age of broiler breeder, age of maturity, canal under waterers, body weight at 24 week of age, season, protein intake/day, total feed intake, age*energy intake/day and age*total feed intake had a significant effect on egg production from start to peak in broiler breeders (Table 2). Age of broiler breeders had a dramatic effect on egg production linearly (p<0.05). Being the same age is very important because it leads to uniformity in egg production. In this study, age of maturity index is assessed as the first egg production. It is thought that delaying egg production causes less egg production to peak but data analysis showed that delaying age of maturity after 24 weeks, increases uniformity and subsequent egg production in broiler breeders. In some farms canal under waterers was used. The results (Fig. 1) showed that mean egg production in farms with canals was lower than those of farms with no canal under waterers (52 vs 63%). The reason of this result is not clear. It might be due to the different type of waterers in farms with canal or because of unknown factors in farms with canals resulted a negative effect on egg production. There was an interaction effect between age and energy intake/day on egg production (Fig. 2). Egg weight and egg production toward the peak increases, therefore energy

Table 2: Analysis of variance of factors affecting egg production from start to peak

Source of variation	Df	SS	F value	p value
24-week body weight	1	158.50	3.39	0.0068
Age of maturity	1	1672.17	35.82	0.0001
Canal under waterer	1	795.95	17.05	0.0001
Age	1	18433.66	394.96	0.0001
Age*energy intake/day	1	986.69	21.14	0.0001
Season	3	4208.77	15.02	0.0001
Age*total feed intake	1	14686.08	314.67	0.0001
Total feed intake	1	12638.09	270.79	0.0001
Protein intake/day	1	545.70	11.69	0.0008

R² = 0.94, R² adjust = 0.91, p<0.05

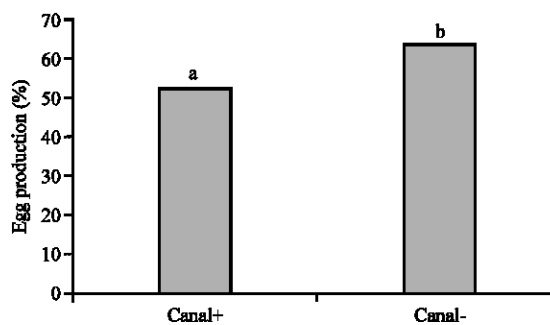


Fig. 1: Effect of canal under waterer on mean egg production from start to peak. ^{a,b} Means with different letters on bars are significantly different (p<0.05)

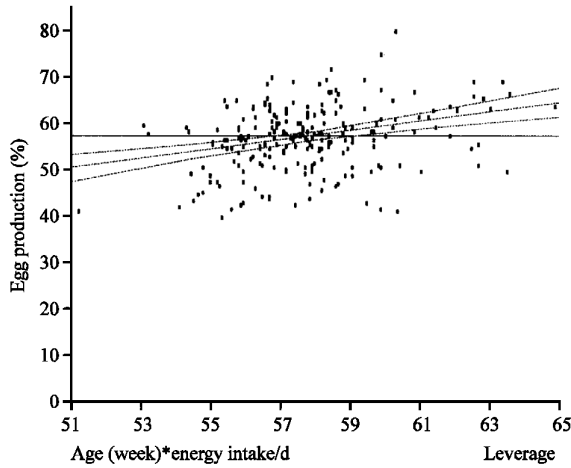


Fig. 2: Age *energy intake/day interaction effect on egg production from start to peak. The Leverage plot is a point-by-point display of how the hypothesis sum of square is composed

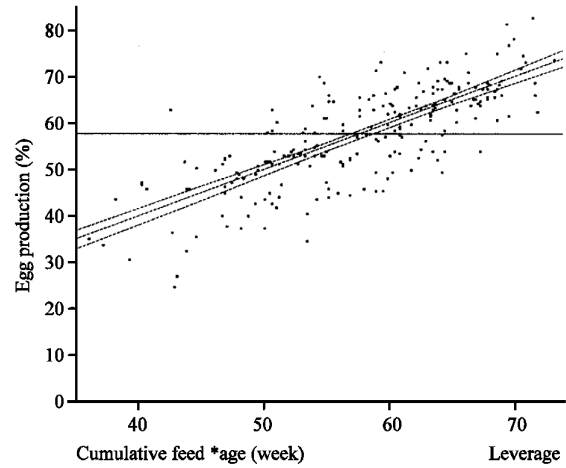


Fig. 4: Age *total feed intake/day interaction effect on egg production from start to peak. The Leverage plot is a point-by-point display of how the hypothesis sum of square is composed

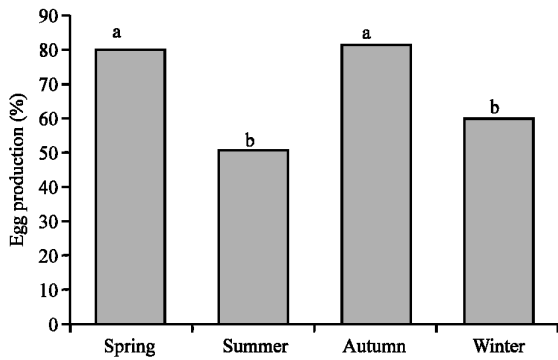


Fig. 3: Effect of season on mean egg production from start to peak. ^{a,b} Means with different letters on bars are significantly different ($p < 0.05$)

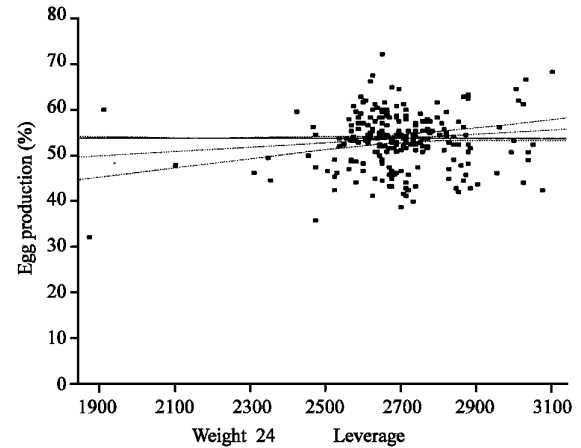


Fig. 5: Effect of breeder weight at 24 weeks of age on egg production from start to peak. The Leverage plot is a point-by-point display of how the hypothesis sum of square is composed

requirement of broiler breeder must be increased. In this situation, requirement of energy compared to protein increases (Cobb 500 breeder management guide, 1995). Decreasing energy intake during peak diminishes egg production (Lesson and Summers, 1988). So, when broiler breeders are in positive energy condition, egg production would be optimized. Seasons (Fig. 3) had a significant effect on egg production ($p < 0.05$). In seasons of spring and autumn, mean egg production was significantly higher than those of summer and winter (80.03, 81.08, 50.16 and 60%, respectively). It is possible that temperature in semi arid area of Birjand had a significant effect on egg production. There was an interaction between age and total feed intake and these items had positive and direct effect on egg production (Fig. 4). If broiler breeders are in lower weights, it is better to allocate

more feed to them. Managers should allocate more feed to heavier birds too. A steady increase in body weight through peak production resulted higher egg production (Wilson and Harms, 1984). Birds consume more feed as their age increases so their maintenance requirements are higher; moreover, their requirement for egg production should be provided and for these reasons they should receive more feed. It is also important to differentiate between feed allocation to heavier bird and overfeeding. Body weight at 24 weeks of age had a significant effect on egg production from start to peak (Fig. 5). Being heavier at 24 weeks is suitable for broiler breeders and support

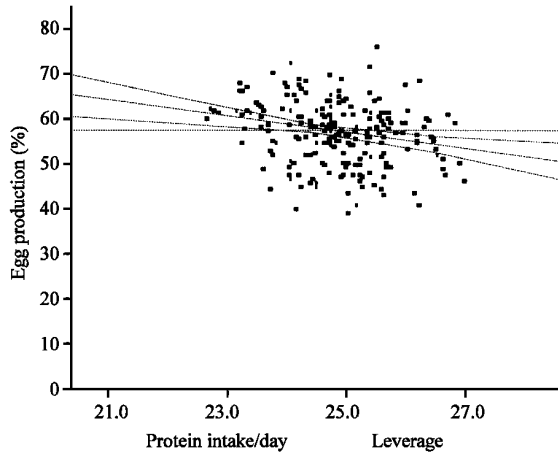


Fig. 6: Effect of protein intake/day on mean egg production from start to peak. The Leverage plot is a point-by-point display of how the hypothesis sum of square is composed

higher egg production. These results are in agreement with those of Petite *et al.* (1982) who showed that compared to 20 and 22 weeks weight, 24 weeks weight is the best indicator in prediction future performance of broiler breeders towards peak. The fact that birds seem better when they are heavier at 24 weeks of age, is likely a factor of better efficacy in the future. Increasing protein intake from 23 to 27 g/hen/day decreased mean egg production (Fig. 6). It is possible that increasing protein intake causes higher levels of amino acids in the blood and this situation may have some effect on hypothalamus center therefore decrease feed intake and egg production. It is also possible that increasing protein intake, accelerates protein metabolism in kidney and liver and consequently ability of these organs for providing enough calcium in uterus for shell gland decreases and therefore egg production declines.

Attention to all of the environmental factors can improve egg production in broiler breeders. Monitoring energy requirement of broiler breeders is very important from start to peak of production. Farmers should note that heavier body weight at 24 weeks of age in broiler breeders is a better indication of subsequent flock performance than that of 20 or 22 weeks of age. Protein allocation should not be more than 23 g/hen/day from start to peak of production.

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