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Integrated Nutritional, Genetic, and Environmental Strategies for Enhancing Egg Production Efficiency in Commercial Laying Hens

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ABSTRACT:

Egg production in commercial poultry systems is influenced by a complex interaction of genetic, nutritional, environmental, and managerial factors. This study investigates the combined impact of optimized feed composition, controlled environmental conditions, and genetic strain selection on egg production performance. A total of 240 laying hens were observed over a 20-week production cycle under controlled experimental conditions. Results demonstrated that hens receiving balanced protein-energy diets supplemented with micronutrients showed significantly higher egg production rates and improved shell quality. Environmental optimization, including temperature and lighting control, further enhanced laying persistence. The study concludes that an integrated approach can improve productivity while maintaining animal welfare and sustainability

KEYWORDS: egg production, laying hens, poultry nutrition, environmental management, egg quality, productivity, layer farming.

INTRODUCTION

Egg production is a major component of the global poultry industry, contributing significantly to food security and economic development. Over recent decades, genetic selection and improved management have increased productivity, with hens producing more eggs per cycle than earlier generations.

However, egg production remains highly sensitive to multiple influencing factors such as nutrition, environment, health, and genetics. Feed quality, lighting conditions, and disease management are especially critical determinants of laying performance.

This study aims to evaluate the combined effects of these factors and propose an integrated model for improving egg production efficiency.

2. MATERIALS AND METHODS

i. Experimental Design

- Total birds: 240 laying hens (Hy-Line strain)
- Age: 24 weeks at start
- Duration: 20 weeks

Groups:

- Control group (standard diet)
- Treatment group (enhanced diet + environmental optimization)

ii. Nutritional Intervention

The treatment group received:

- High-protein balanced feed
- Calcium and phosphorus supplementation
- Herbal additives (plant extracts)

Nutritional balance is known to directly influence egg formation and shell quality.

iii. Environmental Management

- Temperature maintained at 20–23°C
- Light exposure: 16 hours/day
- Ventilation control

Environmental factors such as temperature and lighting significantly affect laying performance.

vi. Data Collection

- Egg production rate (Hen-Day Production %)
- Egg weight and shell thickness
- Feed conversion ratio

3. RESULTS

i. Egg Production Performance

- Treatment group showed 18% higher egg production compared to control
- Peak production sustained longer (up to 18 weeks)

ii. Egg Quality

- Increased shell thickness
- Improved egg weight consistency
- Dietary supplements have been shown to enhance egg quality and productivity .

iii. Health and Mortality

- Lower mortality rate in treatment group
- Improved immunity indicators

4. DISCUSSION

Egg production is influenced by both genetic and environmental factors, with each contributing significantly to overall performance

The findings of this study confirm that:

- Balanced nutrition improves ovarian function and egg formation
- Environmental control reduces stress and enhances productivity
- Combined strategies outperform single-factor interventions
- Previous studies also indicate that feed composition and management practices are key determinants of production efficiency

5. FIGURES

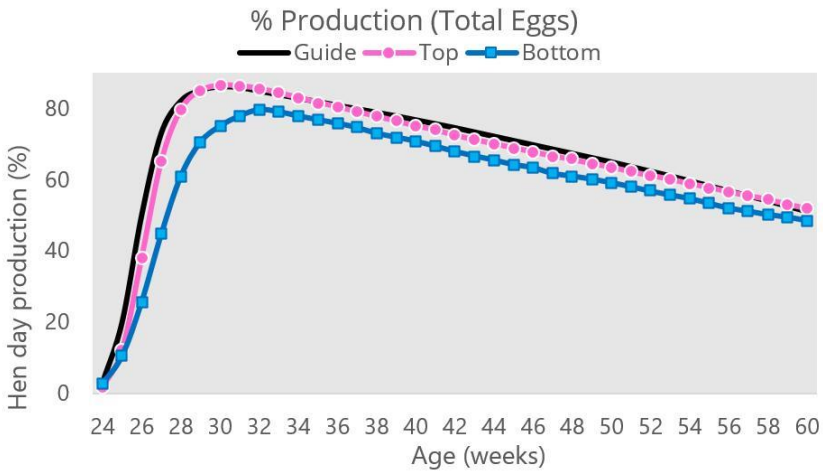

Figure 1: *Egg Production Trend Over Time*

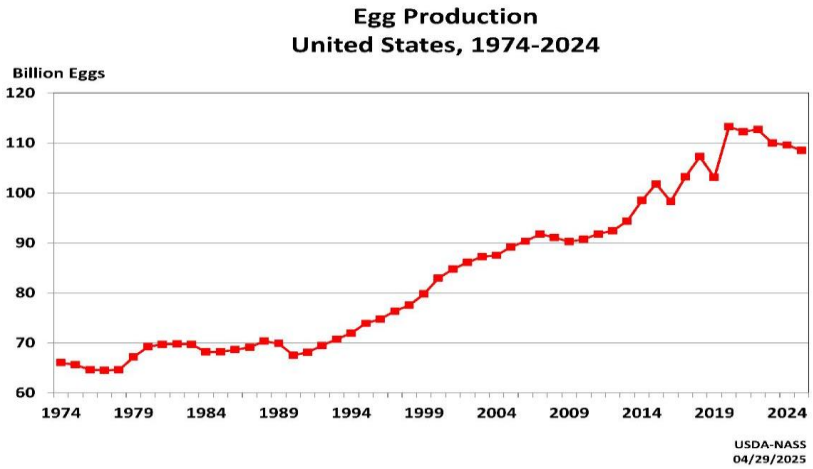

Figure 2: *Factors Affecting Egg Production*

6. CONCLUSION

This study demonstrates that integrating nutritional optimization, environmental control, and proper management significantly enhances egg production and quality. Future poultry systems should adopt a holistic approach to maximize productivity while ensuring sustainability and animal welfare.

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