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Optimizing Layer Feed Composition for Improved Egg Quality

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Abstract

Nutrition plays a significant role in poultry management especially for laying hen who produce eggs which are of high economic value to producers, there is a need to improve the quality of eggs produced by these laying eggs through adequate nutritional measures. The main aim of this review was to examine optimization of layer feed composition for improved egg quality. A Systemic approach was employed to identify organic and inorganic feed composition used by laying hens, feed optimization of laying hens, and factors influencing laying hen's eggs optimization. The findings reveal that both organic and inorganic feed components had significant impacts on laying in egg quality especially in the terms of egg weight, shell thickness, and Haugh unit. Mineral feed additions like Zinc helps to improve laying eggs during high stress conditions, while methionine acts as antioxidants. Crude protein promotes enzymatic activities which promotes egg formation. Feed optimization improves feeding efficiency and egg quality of laying hens. Several factors influence laying hens egg quality ranging from feeding, genetic history, and environment. The study concludes that a combination of mineral and organic trace feed composition coupled with proper feed optimization patterns daily could improve the egg qualities of laying hens. The study recommends the need for poultry producers to adopts nutrition feeding plan which accommodates important feeding composition and optimization plans.

Keywords: *Optimization, Eggs, Quality, Layers, and hen*

Introduction

The best strategy to maintain high hen-day output, eggshell integrity, and internal quality throughout long laying cycles is to optimize each hen's daily consumption of accessible nutrients rather than depending only on dietary percentages in feed (Poudel, 2025). In order to maximize laying hen productivity and egg quality, microminerals are crucial to poultry nutrition (Atmaja et al. 2024). boosting egg production is the top aim for farmers, breeding firms, and feed companies. This is currently achieved by boosting older hens' lay persistence and egg quality stability (Yves, 2015). Due to their low cost, eggs have become a major consumer product globally, have significant economic worth, and are a great source of animal protein [Mottet and Tempio, 2017]. Interest in the internal nutritional makeup of eggs, such as the amount and percentage of omega-3 and omega-6 unsaturated fatty acids in the egg yolk, is growing as living standards in both industrialized and developing nations continue to rise (Gao et al. 2023). Breeders and producers are paying more attention to the crucial function that dietary oils play in livestock and poultry feed as a result of ongoing advances in the performance of these animals.

The need to satisfy the various demands of consumers, the poultry sector is now concentrating on ways to increase egg quality and boost egg production performance. In order to prevent laying birds from taking energy from sources such as their body protein, which would lower their production level and cause them to lose weight, the birds should be fed feeds with the proper energy level. This happens as a result of a lack of energy compromising its muscle mass. Even though these associations are widely recognized in commercial feed formulation today, it would be ideal to confirm the somewhat outdated findings using contemporary hybrid layers in order to measure the impacts and improve suggestions (Jeroch, 2011). Laying hens must consume more protein and energy in the morning (AM) and more calcium (Ca) in the afternoon/evening (PM) to produce eggs than during the rest of the day. To better address the needs of hens than with traditional approaches, poultry experts are attempting to implement a novel feeding strategy known as AM/PM or split feeding (Akter, *et al.* 2025). Due to the high initial costs, agricultural technology in the past was mostly centered on animal production, which required larger investments and higher feeding costs.

However, nutritional strategies to more precisely meet poultry nutrient requirements are becoming crucial for economic sustainability due to growing economic challenges like fluctuating egg prices (Moss *et al.* 2021) and the fact that feed accounts for more than 65% of the costs associated with live poultry production (Wilkinson, 2018). When accounting for calcium retention, hens need 4 g of calcium per day and export 2.2 g per egg (Nys., 2015). Giving layer hens distinct morning and evening feeds may help them obtain the particular nutrients required at different times of the day because the retention time of feed in the digestive tract of poultry is notably short,

averaging about 5 to 6 hours (Svihus and Itani, 2019). Improved egg quality and layer skeletal health are two productivity and financial advantages of this morning (AM)/evening (PM) feeding method.

The main objective was to assess optimizing layer feed composition for improved egg quality.

Thus, the purpose of this review was to: -

a. Examine existing literature: The goal of this review is to provide thorough research into layer feed composition, use of organic and inorganic feed composition for egg quality, feed optimization in layer hens, and factors influencing layer hen egg quality.

b. Composing relevant data from reliable sources and evaluating reputable articles are part of planned results synthesis.

The reputable research platform Research Gate was used in this review. An analysis of the research gate database was done. The main aim was on optimization of poultry feeds especially laying hens, organic and inorganic feed composition, feed optimization in relation to egg quality, and factors influencing laying hens eggs quality. Relevant information from several academic disciplines by using these keywords. Articles that were reviewed in a specific quantity included reports, conference proceedings, and journal articles.

Inorganic and organic feed composition on Laying hen eggs quality

According to Alagawany *et al.* (2016), crude protein (CP) is crucial for maintaining laying performance because it provides the essential amino acids needed for tissue repair, enzyme activity, and egg production. Organic trace minerals can increase eggshell thickness and decrease fecal mineral retention without adversely affecting layer hen productivity, according to Qiu *et al.* (2020). But nutrient needs are dynamic; they change during different stages of production and are impacted by environmental stresses. In order to decrease metabolic heat load during heat stress (> 30°C), lower FI requires greater nutrient density diets with higher concentrations of energy and amino acids but lower CP (Teyssier *et al.* 2022).

Zinc (Zn) is a vital trace mineral that supports laying hens under stress and is involved in over 300 enzymatic pathways. Its physiological roles include immunological control, metabolic homeostasis maintenance, and antioxidant defense (Mohebbifar *et al.* 2025). By increasing shell thickness, egg weight, Haugh unit, and feed conversion ratio (FCR), studies have demonstrated that zinc supplementation improves laying performance and egg quality (Torki *et al.* 2015). Excessive CP decreases impair both performance and egg quality, although moderate reductions can reduce nitrogen excretion and metabolic heat production (Alagawany *et al.* 2016).

Reduced-CP diets can be balanced by supplementing with feed-grade amino acids, especially methionine (Met), the first limiting amino acid in corn-soybean meal diets (Zhang et al. 2024). According to Kachungwa Lugata *et al.* (2022), Met plays a crucial role in antioxidant defense and methylation activities, and its demand increases significantly under stressful conditions. Because they complement one another, adding both organic and inorganic trace minerals to chicken feed can be a beneficial solution. While Kong *et al.* (2022) also highlights chelation technology that can increase the bioavailability of minerals, Razanova *et al.* (2023) demonstrates that organic trace minerals in the form of chelates can improve growth performance and egg quality.

Feeds optimization in layer hen and egg quality

The optimization of laying hen production and egg quality using a combination of inorganic and organic trace mineral supplementation was investigated by Atmaja *et al.* (2025). The results showed that while adding a mix of inorganic and organic trace minerals (ITMs and OTMs) to the feed can greatly increase the weight and thickness of the eggshells, it has no discernible impact on the laying hens' overall performance. Using a nutritional combination of crude protein, methionine, and zinc, Mohebbifar *et al.* (2023) evaluated the optimization of laying hen productive performance and egg quality under cold stress. The study demonstrates that reducing crude protein enhanced laying performance under cold stress with negligible impacts on the majority of egg quality characteristics; nevertheless, interactions between crude protein and methonine affected albumen quality and egg shape index. Diets containing a specific percentage of the three combinations in the proper proportion had the best results. Akter et al. (2025) claim that morning (AM): afternoon (PM) intake shows that selective feeding takes place between treatments ($p < 0.001$) and that the degree of selection is dependent on the variation in nutrient levels between AM and PM diets. This study found that laying hens' feed efficiency and egg quality are improved when AM/PM feeding is optimized. According to Utami and Akbar (2025), adding fermented leucaena leucocephala (FLM) to laying quail diets efficiently increases nutrient utilization and improves egg production and quality without increasing feed intake; the ideal inclusion level for optimizing benefits seems to be less than 10%.

Factors influencing feed composition among layer hens egg quality

The environment, genetic composition, and feed consumption all have an impact on egg laying. Methionine content caused egg weight to rise, plateauing at 0.36–0.38%. It is easier to adapt the supply of protein and amino

acids to changes in feed intake and hen requirements at a particular age when the daily requirement is estimated in relation to egg weight. The internal quality of the egg (Haugh unit, vitelline membrane) was impacted by hen age, however the primary cause for ending the production period will be a decline in eggshell quality. The most effective and straightforward method to improve eggshell quality and reduce excessive bone loss is to provide an ideal supply of both fine and coarse particle sizes (Nys., 2015). Due to increased excretion levels, the usage of inorganic trace elements has a negative influence on the environment and low bioavailability (G. Lv et al., 2023). According to Adeyemo (2015), egg quality generally refers to all of an egg's attributes that influence a consumer's acceptance of it, or to different standards placed on eggs. A high-quality egg is thought to have a density somewhat higher than that of water, hence it shouldn't float in water. Egg weight increases with each extra gram of protein consumed daily (Bouvarel *et al.*, 2011). In order to prevent competition between pullet growth and egg feed requirements, early sexual maturity and selection for low consumption hens involve controlling feed intake capacity, pullet growth curve, and weight at the beginning of laying. The laying hens provision of essential amino acids and protein also affects egg weight. The health and welfare of hens should also be considered by producers. Hen diet is essential for maximizing the exceptional genetic potential of contemporary chickens in terms of high egg quality and productivity while preventing fatty liver syndrome and bone demineralization (Nys, 2015). Laying hens dietary habits have an impact, which may support sustained egg production and increase producer profitability.

Conclusion and Recommendations

Feed optimization improves feeding efficiency and egg quality of laying hens. Several factors influence laying hens egg quality ranging from feeding, genetic history, and environment. The study concludes that a combination of mineral and organic trace feed composition coupled with proper feed optimization patterns daily could improve the egg qualities of laying hens. The study recommends the need for poultry producers to adopts nutrition feeding plan which accommodates important feeding composition and optimization plans.

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