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EFFECTS OF VITAMIN SUPPLEMENTATION ON FEED INTAKE AND EGG PRODUCTION PERFORMANCE IN COMMERCIAL LAYER CHICKENS, KOLAKA, INDONESIA

Muhammad Askari Zakariah [1]*, Alima Bachtiar Abdullahi [2], Nurul Amin [3], Failal Ulfi Mauliah [4], Ahmad Muhklis Ramdani [1], Edi Usman [4], Ikbal [4], Nurfaillah [4], Muh Fikriadi Darwis [4], Rifaldi [4], Pardawati, Andi Faisal [5] and Vill Janna Ningzi [5]

[1]Department of Animal Science, Universitas Sains Islam Al Mawaddah Warrahmah Kolaka, Kolaka 93511, Indonesia
[2]Department of Animal Science, Politeknik Pertanian Negeri Pangkajene Kepulauan, Pangkep 90671, Indonesia
[3]Department of Animal Science, Universitas Muhammadiyah Parepare, Parepare 91214, Indonesia
[4]Department of Health, Universitas Sains Islam Al Mawaddah Warrahmah Kolaka, Kolaka 93511, Indonesia
[5]Department of Agribusiness, Universitas Sains Islam Al Mawaddah Warrahmah Kolaka, Kolaka 93511, Indonesia
[5]Department of Management Education, Islamic Universitas Sains Islam Al Mawaddah Warrahmah Kolaka, Kolaka 93511, Indonesia
[6]Department of English, Universitas Sains Islam Al Mawaddah Warrahmah Kolaka, Kolaka 93511, Indonesia

**Corresponding author*: askari@usimar.ac.id

ABSTRACT

This study aimed to evaluate the effects of different commercial multivitamin supplements on feed intake and egg production performance of laying hens under tropical environmental conditions in Kolaka, Southeast Sulawesi, Indonesia. A total of 1,300 Isa Brown hens were observed for 12 consecutive weeks in a commercial layer farm managed under a semi-intensive production system. Four commercial multivitamin formulations, namely Vita stress®, d, Kumavit®, and Fortevit®, were administered through drinking water according to the farm's supplementation schedule. Weekly data on feed intake (g/bird/day) and egg production rate (%) were collected and analyzed using one-way analysis of variance (ANOVA), followed by Duncan's Multiple Range Test (DMRT) at a significance level of $P<0.05$. The results showed that vitamin supplementation significantly influenced feed intake and egg production performance. Hens supplemented with Vita stress® showed the highest feed intake (111.57 ± 2.88 g/bird/day) and egg production rate ($92.44 \pm 0.35\%$) compared with the other supplementation groups ($P<0.05$). The improved performance observed in the Vita stress® group may be associated with its balanced vitamin–electrolyte composition, which supports nutrient utilization and physiological stability under tropical conditions. In contrast, the lower performance observed in the Fortevit® and Egg stimulant® groups may be related to differences in formulation composition and antioxidant capacity. In conclusion, commercial multivitamin supplementation can help maintain laying performance under hot and humid environmental conditions. Among the tested formulations, Vita stress® showed the most favorable effect on feed intake and egg production, suggesting its potential application for improving layer productivity in tropical farming systems.

Keywords: Vitamin supplementation, Feed intake, Egg production, Layer chicken, Ration formulation, and Tropical poultry farming.

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1. INTRODUCTION

The poultry industry plays a pivotal role in supporting food security, human nutrition, and rural livelihoods, particularly in developing countries such as Indonesia. Eggs are among the most affordable and accessible sources of animal protein and have become increasingly important in meeting the nutritional demands of a growing population. Asia contributes more than 64% of global egg production (FAO, 2013), and Indonesia has experienced continuous growth in the layer industry, as reflected by increasing national egg production reported by livestock statistics (Anonymous, 2023). However, maintaining high productivity and efficiency in commercial layer farming remains challenging due to variations in feed management, environmental conditions, and

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nutritional adequacy.

Feed intake is a primary factor determining egg production because it directly influences nutrient availability for maintenance and egg formation. In tropical regions, high ambient temperature and humidity can reduce feed consumption, disturb nutrient metabolism, and impair production performance and egg quality (Leeson & Summers, 2005; Wasti et al., 2020; Brugaletta et al., 2022). Therefore, nutritional strategies that support physiological adaptation under tropical conditions are increasingly important.

Vitamin supplementation has received considerable attention as a practical nutritional approach to maintain poultry performance under environmental stress. Vitamins function as essential metabolic regulators involved in antioxidant defense, immune response, enzymatic activity, and reproductive processes (McDowell, 2000; Combs, 2012). Particularly under heat stress conditions, antioxidant-related vitamins such as vitamins E and C have been reported to improve physiological stability and production responses in laying hens (Puthpongsiriporn et al., 2001; Çiftçi et al., 2005; Ajakaiye et al., 2010). Other vitamins, including vitamins A, D3, K, and B-complex, also contribute to maintaining normal metabolic functions, calcium utilization and overall health status (McDowell, 2000).

In commercial layer production systems, farmers commonly apply combined multivitamin formulations through drinking water as a management strategy during periods of environmental challenge. These commercial formulations usually contain combinations of vitamins and electrolytes designed to support nutrient utilization, reduce physiological stress, and maintain productive performance. However, responses to different commercial formulations may vary depending on their composition, antioxidant capacity, and management conditions.

Despite extensive research on vitamin supplementation under controlled experimental conditions, field-based evidence from commercial layer farms in tropical environments remains limited. Practical farm conditions, including local climate, management systems, and routine supplementation practices, may influence the effectiveness of vitamin interventions. Therefore, evaluating commercial vitamin supplementation using real-world farm production data is essential for providing practical recommendations for tropical poultry production systems.

This study aimed to evaluate the effects of different commercial multivitamin supplements on feed intake and egg production performance of laying hens under tropical conditions in Kolaka, Southeast Sulawesi, Indonesia. Using weekly production records from a commercial layer farm, this study provides field-based insights into the relationship between vitamin supplementation practices and laying performance. The findings are expected to inform improved nutritional management strategies to enhance the productivity and sustainability of layer farming in hot, humid tropical environments.

2. MATERIALS AND METHODS

2.1. Experimental Site and Animal Management

This study was conducted at RL Farm, a commercial layer chicken farm located in Samaturu District, Kolaka Regency, Southeast Sulawesi, Indonesia. The farm housed approximately 1,300 Isa Brown laying hens managed under a semi-intensive production system with battery cage housing. The main production output was commercial table eggs supplied to the local market in Kolaka Regency.

The observation period lasted 12 consecutive weeks (March–May 2025) during the active laying phase (24–36 weeks of age). Farm management practices, including feeding schedules, drinking water management, cleaning procedures, egg collection, and vitamin supplementation routines, were recorded through direct observation of daily activities and supported by farm records and interviews with the farm owner.

The farm was located in a tropical lowland environment, where daily ambient temperatures ranged from 28 to 33°C and relative humidity ranged from 70 to 85%. These hot, humid conditions pose a potential heat-stress challenge for laying hens, as elevated temperature and humidity may reduce feed intake, impair nutrient utilization, and negatively affect laying performance and egg quality (Lara & Rostagno, 2013; Wasti et al., 2020; Kim et al., 2025).

2.2. Feed Formulation and Preparation

The layer diet used in this study was the routine farm-formulated ration applied at RL Farm. The ration was prepared using locally available feed ingredients, including ground maize (corn), commercial layer concentrate, and rice bran (dedak). The ingredients were mixed using a feed mixer to obtain a uniform ration before being provided to the laying hens.

The standard formulation used during the observation period consisted of 50% ground maize, 35% layer concentrate and 15% rice bran (Table 1). This formulation reflects the semi-self-mixing feeding practice commonly adopted on Indonesian layer farms, in which commercial concentrates are combined with locally available energy sources such as maize and rice bran (Rasyaf, 2012). Maize primarily contributes dietary energy, whereas rice bran

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provides additional energy and nutrients; meanwhile, the commercial concentrate supplies essential protein, minerals, vitamins, and other nutrients required for laying hen production (NRC, 1994; Leeson & Summers, 2005).

The nutrient composition of the diet, including crude protein, metabolizable energy, calcium, and phosphorus, was determined using the nutrient specifications of the commercial concentrate and the ingredient composition provided by the supplier.

Table 1: Composition of experimental layer diet

Ingredient	Percentage (%)
Ground Maize	50
Layer Concentrate	35
Rice Bran	15
Total	100

All ingredients were weighed according to the required proportions and thoroughly mixed in the feed mixer to achieve a uniform diet. The feed was prepared regularly in batches to ensure freshness and consistency.

2.3. Vitamin Supplementation Protocol

The multivitamin preparation used was Fortevit® (PT Medion Farma Jaya, Bandung, Indonesia), a commercial water-soluble poultry multivitamin. Based on the product information, Fortevit® is indicated for chicks, pullets, layers, and breeders, with dosing in drinking water that varies by purpose (e.g., 10 g/60 L to support growth and help overcome stress, 10 g/15 L to prevent diseases due to vitamin deficiencies, and 10 g/120 L to help maintain egg production at peak levels) (Medion Farma, 2021). On the present farm, Fortevit® was administered at 1 g per 2 L of drinking water, following the farm's routine and in accordance with label guidance. The product's declared vitamin profile includes vitamins A, D_3, E, K_3, B_1, B_2, B_6, B_{12}, vitamin C, niacin, plus folic acid, biotin and calcium D-pantothenate (Direktorat Jenderal Peternakan dan Kesehatan Hewan, 2020).

2.4. Feeding Management

Layers at RL Farm were provided with feed formulated as described above. The amount of feed allocated per bird was calculated based on the total population of hens, with a daily provision of approximately 110–120 g/hen/day, which is consistent with typical commercial-layer feed intake ranges reported in breeding-company performance/management standards (Hansjoachim & Nordholz International GmbH, 2024; Hy-Line International, 2025). Feeding was routinely performed at 2:00 PM each day, as determined by the farm's management protocol. This timing was intended to help maintain intake under hot–humid conditions by adjusting feeding time and nutrient availability during cooler periods and shell-formation hours; heat-stress guidance for layers emphasizes the importance of feeding time management (e.g., allocating a larger proportion of feed in the late afternoon/evening and using additional feeding opportunities at cooler times) to reduce heat load from digestion and support eggshell formation (Lohmann Breeders, 2009; Hansjoachim & Nordholz International GmbH, 2024).

2.5. Data Collection

This study was conducted at a commercial laying-hen farm located in Kolaka Regency, Southeast Sulawesi, Indonesia. The observation period covered weeks 21 to 45 of production, corresponding to the peak and stable egg production phases. The data were obtained from routine production records maintained by the farm management, which included: 1) Age (weeks), 2) Type of vitamin supplementation, 3) Average feed intake (g/bird/day), 4) Egg production rate (%), and 5) Mortality (birds/week). Four commercial vitamins were used alternately during the observation period: Egg stimulant®, Fortevit®, Kumavit®, and Vita stress®. Each vitamin was applied according to the farm's standard management rotation, and no additional treatments were introduced to avoid bias.

2.6. Data Analysis

Descriptive statistics (mean ± SD) were calculated for body weight, feed intake and egg production to summarize the general performance pattern for each vitamin treatment. A one-way Analysis of Variance (ANOVA) was performed to determine the effect of vitamin type on production performance. When significant differences were detected ($P<0.05$), the DMRT test was used for post hoc comparison among treatment means.

3. RESULTS AND DISCUSSION

Descriptive analysis was conducted to identify production trends under different vitamin treatments. Table 2 summarizes the mean and standard deviation of the main performance indicators.

The present study demonstrated that vitamin supplementation significantly affected both feed intake and egg production of laying hens. Among the treatments, birds receiving Vita stress® showed the highest feed intake and egg production, while those supplemented with Fortevit® and Egg stimulant® showed lower performance. This finding indicates that different multivitamin formulations may contribute variably to metabolic support, stress

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tolerance, and productive efficiency in layers, depending on their vitamin profile and the birds' physiological needs under farm conditions.

Table 2: Mean performance of laying hens under different vitamin treatments (weeks 21–45)

Parameter	Vita stress® (mean ± SD)	Egg stimulant® (mean ± SD)	Kumavit® (mean ± SD)	Fortevit® (mean ± SD)	P-value (ANOVA)
Feed intake (g/bird/day)	111.57 ± 2.88[a]	105.44 ± 7.00[b]	104.29 ± 1.24[b]	102.00 ± 9.36[b]	0.0001
Egg production (%)	92.44 ± 0.35[a]	81.52 ± 23.47[b]	86.84 ± 1.89[b]	74.28 ± 36.15[b]	0.0373

Different superscript letters within the same row indicate significant differences (P<0.05) according to Duncan's Multiple Range Test (DMRT).

The higher feed intake and egg production observed in hens supplemented with Vita stress® may be associated with its role as an anti-stress supplement containing a combination of vitamins and electrolytes. This formulation is particularly relevant in tropical, hot, and humid conditions, where laying hens commonly experience reduced feed intake, oxidative stress, and disturbances in acid–base balance. Previous studies have consistently demonstrated that heat stress negatively affects feed consumption, egg production, and physiological stability in poultry, while nutritional interventions involving antioxidant vitamins and electrolyte supplementation may partially alleviate these adverse effects (He et al., 2018; Wasti et al., 2020; Livingston et al., 2022). In practical poultry management, vitamin and electrolyte supplementation through drinking water is also commonly recommended during periods of heat stress to support bird performance and maintain hydration status (University of Minnesota Extension, 2026).

Commercial multivitamin-electrolyte products are widely used in practical poultry production systems to support birds during stressful conditions. In Indonesian layer farming, Vita Stress® has been administered via drinking water as part of routine management practices to reduce stress and maintain production (Qurniawan et al., 2023). However, the physiological response to commercial supplementation may depend on the formulation, nutrient composition, environmental conditions, and production system. Commercial supplements such as Egg Stimulant® have been applied in practical layer farming systems in Indonesia as part of management strategies to support egg production (Sarfan & Papilaya, 2023).

The present findings are consistent with previous experimental studies demonstrating the beneficial effects of antioxidant vitamins under heat-stress conditions. Puthpongsiriporn et al. (2001) reported that supplementation with vitamins C and E improved productive performance and antioxidant status in laying hens exposed to high environmental temperatures. Similarly, Ajakaiye et al. (2010) observed improved production performance in laying hens supplemented with vitamins C and E under hot tropical conditions. In addition, Abidin and Khatoon (2013) concluded that vitamin C supplementation could help mitigate several negative consequences of heat stress in poultry, including reduced feed intake, decreased productivity, and impaired egg quality.

Feed intake may also serve as an indirect indicator of physiological comfort and environmental adaptation in poultry. Under heat stress, birds generally reduce voluntary feed intake to minimize metabolic heat production. Therefore, supplementation strategies that support thermotolerance, antioxidant defense, and electrolyte balance may help stabilize feed intake and maintain laying persistency (He et al., 2018; Wasti et al., 2020). The differences observed among Vita stress®, Fortevit®, Egg stimulant®, and Kumavit® in the present study may therefore be associated with variations in formulation characteristics, including vitamin composition, electrolyte content, dosage administered through drinking water, and nutrient availability under commercial farm conditions.

Previous research by Tsani et al. (2026) demonstrated that Egg stimulant® supplementation was associated with egg productivity in Layar hybrid chickens, although productive variation was also influenced by biological factors, including variation in the prolactin (PRL) gene promoter. These findings suggest that the response to commercial egg production supplements may depend not only on nutrient composition but also on physiological and genetic backgrounds of laying hens.

The improved egg production observed in the better-performing supplementation treatment is also supported by previous findings indicating that adequate vitamin supply can enhance laying performance and egg quality, particularly under stressful environmental conditions. Gan et al. (2020) demonstrated that higher dietary vitamin supplementation improved laying performance and vitamin deposition in eggs. Conversely, Choi et al. (2025) reported that reducing vitamin premix levels negatively affected laying performance and egg vitamin content in commercial layers. These findings indicate that productive responses are highly dependent on the adequacy and effectiveness of vitamin supplementation provided to birds.

Recent studies further support the interpretation that nutritional supplementation plays an important role in alleviating heat-stress-related declines in poultry production. Kim et al. (2024) demonstrated that severe heat stress significantly reduced feed intake, egg production rate, eggshell quality, and physiological stability in laying hens exposed to high temperature–humidity index conditions. Similarly, Oke et al. (2024) emphasized that oxidative stress is a major biological consequence of heat stress in poultry, contributing to impaired metabolism, immune imbalance, and reduced productive performance. These findings support the present observation that birds receiving more comprehensive anti-stress supplementation exhibited better feed intake and egg production performance under tropical farm conditions.

Recent reviews have also highlighted the growing importance of antioxidant-based nutritional strategies in poultry production systems facing climate-related environmental stress. Kim et al. (2021) reported that heat stress substantially alters energy metabolism and increases oxidative damage in poultry, thereby necessitating nutritional interventions that improve antioxidant defense mechanisms and physiological adaptation. Likewise, Mahasneh et al. (2024) explained that prolonged heat stress increases reactive oxygen species (ROS) production and suppresses endogenous antioxidant enzyme activity, ultimately reducing productivity and feed efficiency. The authors emphasized that antioxidant supplementation may help minimize oxidative damage to cells during heat exposure.

Additional evidence from laying hens indicates that vitamin-based nutritional interventions may improve antioxidant status and reproductive performance. Furthermore, Li et al. (2024) concluded that oxidative stress negatively affects intestinal health and nutrient absorption in poultry, thereby reducing productive efficiency. Their review highlighted the growing importance of antioxidant nutritional interventions for maintaining poultry productivity under stressful environmental conditions.

Recent publications from 2025 further confirm the importance of nutritional interventions during heat stress exposure. Aryal et al. (2025) reviewed the major oxidative and antioxidant mechanisms activated during heat stress in chickens and concluded that nutritional supplementation remains one of the effective approaches for improving cellular antioxidant defense systems. Similarly, Olayiwola et al. (2025) demonstrated that heat stress induces oxidative damage in reproductive organs of laying birds, resulting in reduced egg production and reproductive efficiency. These findings are consistent with the lower productive performance observed in treatment groups receiving less effective supplementation strategies in the present study.

More recent studies have further confirmed the role of nutritional supplementation in improving physiological adaptation of laying hens under heat stress conditions. Kwon et al. (2023) reported that supplementation with functional nutrients improved productive performance, egg quality, and health indicators of laying hens exposed to heat stress. Similarly, Han et al. (2023) demonstrated that supplementation with antioxidant-related nutrients, including vitamin C, vitamin E, and betaine, improved antioxidant status and reduced physiological stress responses in heat-stressed laying hens.

Overall, the integration of findings from previous and recent studies published between 2023 and 2026 confirms that heat stress remains a major limiting factor in commercial poultry production. Nutritional supplementation strategies involving vitamins, antioxidants, and electrolyte balance may therefore improve feed intake, oxidative stability, and egg production performance in laying hens maintained under challenging tropical environmental conditions. Recent evidence also highlights that nutritional and biochemical strategies involving antioxidant and osmoprotective additives can improve physiological adaptation and resilience of poultry exposed to heat stress (Sumanu et al., 2024; Tesakul et al., 2025; Wang et al., 2025; Tobolska et al., 2026). Nevertheless, responses to supplementation may vary depending on stress intensity, diet composition, environmental management, delivery method, and baseline nutrient status. Therefore, further replicated and controlled field studies are recommended to confirm the effectiveness of different supplementation strategies under commercial tropical production systems. Recent advances in heat stress mitigation strategies further emphasize that nutritional interventions, including antioxidant supplementation, vitamin administration, and electrolyte management, represent important approaches for improving resilience and maintaining productivity of laying hens under climate change-related environmental challenges (Idowu et al., 2026).

4. CONCLUSION

The study concluded that vitamin supplementation significantly influenced feed intake and egg production of laying hens, with Vita stress® yielding the best performance due to its balanced multivitamin and electrolyte formulation. These results highlight the importance of selecting antioxidant-rich vitamin supplements to sustain productivity under tropical heat stress conditions.

Declarations

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Data Availability: Data will be available upon reasonable request from the corresponding author.

Ethics Statement: The authors confirm that all procedures conducted in this study complied with ethical standards of research and institutional guidelines. No animals or humans were harmed during the study, and all data collection and analyses were carried out responsibly and ethically.

Author's Contribution: M.A.Z. and A.A.B designed and performed the experiments, analyzed the data, wrote the original paper, and edited. F.U.M. and A.M.R conceptualization, writing the original paper, and supervision. E.U., Ikbal, Nurfaillah, M.F.D, Rifaldi, and Pardawati conceptualization and supervision. All authors contributed to this manuscript.

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