Productive Performance of Laying Japanese Quail Fed Diets Containing Babadotan (*Ageratum conyzoides*) Leaf Meal

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ABSTRACT

This study assessed the impact of babadotan (*Ageratum conyzoides)* leaf meal supplementation on the egg production of Japanese quail (Coturnix coturnix japonica). A fully randomized design was implemented utilizing four dietary treatments: 0% (R0), 1% (R1), 3% (R2), and 5% (R3) babadotan leaf meal. One hundred forty female quails, aged 6 to 12 weeks, were monitored over a period of six weeks. The characteristics assessed included egg weight, quail daily production, egg mass, feed conversion ratio (FCR), and mortality rate. The nutrient profile of the meals was comparably consistent throughout treatments, with crude protein varying from 22.48% to 22.61%, although crude fiber exhibited a modest rise corresponding to the rising inclusion amount of babadotan leaf meal. The findings indicated that the supplementation of babadotan leaf meal did not yield a statistically significant impact on egg output. Egg weight increased marginally from 10.39±0.29 g in R0 to 10.53±0.13 g in R3; however, the change was not statistically significant. The control group exhibited the highest quail day production (44.56±3.54%), whereas R2 demonstrated the lowest (36.06±10.55%). Additionally, feed conversion ratio (FCR) was most efficient in the control group (5.09±0.74) and showed a tendency to deteriorate in the supplemented groups. Mortality was consistently 0% across all treatments, signifying that all birds were kept in optimal health throughout the experiment. In conclusion, the incorporation of babadotan leaf meal up to 5% did not markedly enhance the egg production of Japanese quail, although it can be added without adverse effects on avian health.

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ABSTRAK (in Indonesian)

Penelitian ini menguji pengaruh suplementasi tepung daun babadotan (*Ageratum conyzoides*) terhadap produksi telur burung puyuh Jepang (*Coturnix coturnix japonica*). Rancangan acak lengkap diterapkan dengan menggunakan empat perlakuan ransum: 0% (R0), 1% (R1), 3% (R2), dan 5% (R3) tepung daun babadotan. Seratus empat puluh burung puyuh betina, berusia 6 hingga 12 minggu, diamati selama enam minggu. Karakteristik yang dinilai meliputi berat telur, produksi harian burung puyuh, massa telur, rasio konversi pakan (FCR), dan tingkat kematian. Profil nutrisi tepung relatif konsisten di seluruh perlakuan, dengan protein kasar bervariasi dari 22,48% hingga 22,61%, meskipun serat kasar menunjukkan peningkatan moderat yang sesuai dengan peningkatan jumlah penambahan tepung daun babadotan. Temuan menunjukkan bahwa suplementasi tepung daun babadotan tidak memberikan dampak yang signifikan secara statistik terhadap produksi telur. Berat telur meningkat sedikit dari 10,39±0,29 g pada R0 menjadi 10,53±0,13 g pada R3; namun, perubahan tersebut tidak signifikan secara statistik. Kelompok kontrol menunjukkan produksi telur puyuh per hari tertinggi (44,56±3,54%), sedangkan R2 menunjukkan yang terendah (36,06±10,55%). Selain itu, rasio konversi pakan (FCR) paling efisien pada kelompok kontrol (5,09±0,74) dan menunjukkan kecenderungan memburuk pada kelompok yang diberi suplemen. Angka kematian konsisten 0% di semua perlakuan, yang menunjukkan bahwa semua unggas tetap dalam kondisi kesehatan optimal selama percobaan. Kesimpulannya, penambahan tepung daun babadotan hingga 5% tidak secara signifikan meningkatkan produksi telur puyuh Jepang, meskipun dapat ditambahkan tanpa efek samping pada kesehatan unggas.

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INTRODUCTION

Japanese quail (*Coturnix coturnix japonica*) are increasingly recognized as an efficient egg-producing poultry species because they mature early, require relatively little space and capital, and can be managed in both smallholder and commercial systems. These features make quail production relevant to efforts to improve the supply of affordable animal protein, particularly in developing production contexts (Khaskheli, 2020; Ratriyanto et al., 2020; Zotte & Cullere, 2024). However, the productive performance of laying quail is strongly influenced by the interaction of nutrition, genotype, environment, and management. Among these factors, feed remains the most practical intervention point because it directly affects egg production, egg weight, egg mass, and feed conversion efficiency. Previous studies have shown that dietary protein balance, energy density, mineral adequacy, and environmental stressors such as heat and stocking density can markedly influence laying performance in Japanese quail (Salih et al., 2021; Sarmiento-García et al., 2022; Rabie et al., 2023; Santana et al., 2021).

A major challenge in quail nutrition is to improve productivity without increasing dependence on costly conventional ingredients or synthetic additives. For this reason, attention has shifted toward phytogenic feed additives, including herbs, extracts, essential oils, and leaf meals, which may support digestive health, microbial balance, and nutrient utilization. In laying quail, several plant-derived additives have shown promising but inconsistent effects on productivity and egg quality, suggesting that their efficacy depends on additive type, dosage, diet composition, and production conditions (Çabuk et al., 2014; Nurjanah et al., 2023; Abbas & Al-Jrrah, 2022). These findings indicate that phytogenic additives may offer a practical nutritional strategy, but each botanical candidate still requires specific evaluation before it can be recommended for use in quail diets.

One plant of interest is *Ageratum conyzoides* (babadotan), which is widely known for its medicinal properties and diverse phytochemical composition. Previous studies have reported that this plant contains flavonoids, phenolics, alkaloids, tannins, terpenoids, saponins, and other bioactive compounds associated with antimicrobial, antioxidant, anti-inflammatory, and gastroprotective effects (Kotta et al., 2020; Yadav et al., 2019; Bamba et al., 2023; Baral et al., 2022). From a poultry nutrition perspective, these properties suggest a potential role in supporting gut health and improving nutrient absorption, which could ultimately contribute to better laying performance. This rationale is consistent with broader evidence showing that biologically active plant materials and fermented leaf products can improve nutrient intake, egg production, or feed efficiency under certain feeding conditions (Hartady et al., 2021; Ratriyanto et al., 2021; Utami & Akbar, 2025). Nevertheless, most of the available evidence on *A. conyzoides* remains focused on phytochemical characterization and pharmacological activity rather than direct evaluation in laying Japanese quail.

Therefore, a clear research gap exists regarding the use of babadotan leaf meal as a phytogenic additive in layer-phase Japanese quail diets. Although the plant is biologically promising, empirical evidence on its effects on egg productivity variables remains limited compared with other botanical feed additives (Holanda et al., 2020; Nurjanah et al., 2023; Utami & Akbar, 2025). The present study was conducted to evaluate the effects of dietary supplementation with babadotan leaf meal on egg weight, egg production, egg mass, feed conversion ratio, and mortality in laying Japanese quail. The novelty of this study lies in testing a locally available but underexplored phytogenic material under practical feeding conditions, with the expectation that the results will provide baseline evidence for future work on dose optimization, mechanism, and application in sustainable quail nutrition.

MATERIALS AND METHODS

Research Materials

The biological material used in this study consisted of 140 female Japanese quail (*Coturnix coturnix japonica*) aged 6–12 weeks, with an average initial body weight of approximately 120 g per bird. All birds were obtained from a commercial quail farm located in Ciampea, Bogor, and were selected on the basis of apparent health, body condition, and suitability for the laying phase. Birds showing signs of disease, low body weight, or poor physical performance were excluded from the experiment to minimize non-treatment variation. Drinking water and a commercial disinfectant were provided throughout the study for routine husbandry and sanitation.

The dietary additive evaluated in this experiment was babadotan leaf meal derived from *Ageratum conyzoides*. The use of plant-derived additives in poultry feed has been increasingly explored because phytogenic materials may contribute antimicrobial, antioxidant, and digestive-supportive effects that can improve nutrient use efficiency and productive performance (Hartady et al., 2021; Kotta et al., 2020; Yadav et al., 2019). In this study, babadotan leaf meal was tested as a partial dietary supplement mixed into a commercial quail diet. The basal feed used was a commercial ration (SP-22), formulated for laying quail. The nutrient composition of both the commercial feed and babadotan leaf meal is presented in Table 1.

Table 1. Nutritional content of experimental feed

Feed	Nutrient*					
	DM (%)	CP (%)	CF (%)	EE (%)	Ash (%)	NFE (%)
Commercial Feed	90.73	20.48	6.07	9.11	16.07	39.41
Babadotan Leaf Meal	87.69	25.20	12.94	4.55	12.41	32.59

Note: Laboratorium Illmu dan Teknologi Pakan IPB. 2023

Table 2. Composition and nutrient of experimental feed

Jenis Pakan	R0	R1	R2	R3
Commercial Feed	100%	99%	97%	95%
Babadotan Leaf Meal	0%	1%	3%	5%
Nutrient				
DM (%)	90.73	90.70	90.64	90.59
CP (%)	22.48	22.51	22.56	22.61
CF (%)	6.07	6.14	6.27	6.40
EE (%)	6.70	6.68	6.64	6.60
Ash (%)	16.07	16.03	15.96	15.90
FE (%)	39.41	39.34	39.21	39.09

Caption: R0 = control diet without babadotan leaf meal; R1 = diet containing 1% babadotan leaf meal; R2 = diet containing 3% babadotan leaf meal; R3 = diet containing 5% babadotan leaf meal. The totals are standardized to 100% for formulation consistency.

Table 3. The effect babadotan leaf meal on egg weight, Quail Day and FCR

Feed Trial	R0	R1	R2	R3
Egg Weight (g)	10.39±0.29	10.42±0.24	10.42±0.28	10.53±0.13
Quail Day (%)	44.56±3.54	42.31±7.07	36.06±10.55	42.93±12.43
FCR	5.09±0.74	5.59±1.09	8.29±5.42	5.93±1.67

Caption: R0 = control diet without babadotan leaf meal; R1 = diet containing 1% babadotan leaf meal; R2 = diet containing 3% babadotan leaf meal; R3 = diet containing 5% babadotan leaf meal. The totals are standardized to 100% for formulation consistency.

The experimental diets were formulated using a trial-and-error approach based on the nutrient requirements of laying quail. Nutritional adequacy was considered important because egg production responses in quail are strongly influenced by dietary protein, energy, calcium, and general nutrient balance (Salih et al., 2021; Sarmiento-García et al., 2022; Standar Nasional Indonesia [SNI], 2006). Four treatment diets were prepared by supplementing the commercial feed with graded levels of babadotan leaf meal. The ingredient composition of the experimental rations is shown in Table 2

Equipment

The birds were reared in a tiered cage system consisting of two cage units, each measuring approximately 1.8 m × 0.60 m. Each unit had five tiers, and each tier was partitioned into ten compartments with dimensions of approximately 53 cm × 60 cm. The cage floors were made of wire mesh with a spacing of 1.5 cm × 1.5 cm to facilitate manure removal and egg collection. Each compartment was equipped with an external feed trough and drinker. Illumination was provided by a 40-W incandescent lamp to support routine management and laying activity. Additional equipment used during the experiment included a digital scale for weighing eggs and feed, plastic containers, buckets, markers, stationery, a blender, and a drying oven. The use of standard cage equipment and weighing instruments was intended to ensure consistent husbandry and measurement precision throughout the study.

Experimental Design

The experiment employed a completely randomized design with four dietary treatments and five replications per treatment. Each experimental unit consisted of one cage compartment containing seven female quail, resulting in a total of 20 experimental units and 140 birds. The treatments were defined as follows: R0, a commercial diet without babadotan leaf meal; R1, a commercial diet supplemented with 1% babadotan leaf meal; R2, a commercial diet supplemented with 3% babadotan leaf meal; and R3, a commercial diet supplemented with 5% babadotan leaf meal. This graded inclusion approach was selected to allow evaluation of whether increasing dietary concentrations of babadotan leaf meal would induce measurable changes in laying performance.

The statistical model followed the conventional form of a completely randomized design, in which each observation was expressed as the sum of the overall mean, treatment effect, and experimental error. Data were analyzed using analysis of variance (ANOVA). When a significant treatment effect was detected, Duncan's multiple range test was planned as the post hoc comparison procedure. The choice of ANOVA was appropriate because the design involved one main treatment factor with multiple dietary levels, while the use of a follow-up mean comparison test is commonly recommended in poultry feeding trials to determine differences among treatment groups when the overall F-test is significant (Sudrajat et al., 2014).

Variables Measured

The study evaluated the main indicators of laying productivity, namely feed consumption, egg production, egg weight, egg mass production, feed conversion ratio, and mortality. Feed consumption was determined as the difference between the amount of feed offered and the feed refused, measured weekly for each experimental unit. This variable was included because feed intake is a primary determinant of nutrient availability for maintenance and egg formation, and it can be affected by diet composition and environmental conditions (Wahju, 2011; Anggitasari et al., 2016).

Egg production was recorded daily by counting the number of eggs produced in each cage compartment. Hen-day egg production was then calculated as the proportion of eggs produced relative to the number of live hens, multiplied by 100, following the approach described by Sudrajat et al. (2014). Egg weight was determined from the total egg weight measured over a weekly period divided by the number of eggs collected during the same period. Egg mass production was calculated by integrating egg number and egg weight, thereby reflecting the total quantity of egg output over time. Feed conversion ratio was calculated as the amount of feed consumed divided by egg output, expressed on a weight basis. Lower feed conversion values indicate greater biological efficiency in converting feed into eggs (Triyanto, 2007; Bakrie et al., 2012). Mortality was calculated as the number of dead birds divided by the initial number of birds in each experimental unit, multiplied by 100. Monitoring mortality was important because survivability provides an indirect indicator of bird health, management adequacy, and the safety of the dietary treatment (Wilson et al., 1980).

Experimental Procedure

Cage Preparation

Preparation of the experimental housing began one week before bird placement. The quail house was sprayed with disinfectant and cleaned thoroughly to reduce microbial contamination and create a uniform sanitary environment before the start of the feeding trial. Feeders and drinkers were washed and disinfected prior to use, and all cage compartments were prepared with the necessary equipment for feeding, watering, and egg collection. Proper sanitation before the introduction of birds is essential in quail production because environmental hygiene and cage design can affect stress level, health status, and ultimately laying performance and survivability (Wilson et al., 1980; Ratriyanto et al., 2020).

Quail Preparation

Before the experiment commenced, all birds were inspected individually and screened for visible health problems, poor vigor, or abnormal body condition. Only healthy birds judged suitable for the laying period were assigned to the experimental units. This selection procedure was intended to reduce variation attributable to pre-existing health differences rather than dietary treatment. The birds were then distributed randomly across the treatment groups and allowed to adapt to the experimental environment under routine management conditions.

Preparation of Babadotan Leaf Meal

The babadotan leaf meal used in the experiment was prepared from fresh babadotan leaves separated from stems and petioles. The leaves were dried in an oven at 60°C for 24 h and subsequently ground using a blender until a fine meal was obtained. Drying at a moderate temperature was used to reduce moisture content while maintaining the physical quality of the material for dietary mixing. The processing of plant material into leaf meal in this manner is consistent with the preparation of phytogenic feed ingredients intended for uniform incorporation into poultry rations.

Feeding Management

The basal diet used during the trial was the SP-22 commercial quail ration, administered either alone or mixed with babadotan leaf meal according to treatment. Feed was offered twice daily, in the morning and afternoon, while water was made available continuously. The treatment diets were supplied throughout the six-week observation period. The use of practical feeding times and a commercial basal ration was intended to simulate common production conditions while still allowing controlled evaluation of the supplemental plant meal.

Data Collection

Primary data were collected throughout the experimental period from the beginning to the end of the feeding trial. Feed refusals were recorded regularly to determine feed consumption. Eggs were collected daily, counted, and weighed according to the measurement schedule for each variable. Mortality was monitored continuously and recorded whenever it occurred. These procedures generated the dataset used for statistical analysis of the effect of babadotan leaf meal supplementation on the laying productivity of Japanese quail. Overall, the methodological approach was designed to provide a practical but scientifically structured assessment of whether graded inclusion of babadotan leaf meal could alter productive responses during the layer phase under controlled management conditions.

RESULTS AND DISCUSSION

Table 3 presents the effects of babadotan (*Ageratum conyzoides*) leaf meal supplementation on egg weight, quail day production, and feed conversion ratio in Japanese quail. The data compare the responses of birds fed different dietary inclusion levels, providing an overview of the productive performance observed during the experiment.

Table 3. The effect babadotan leaf meal on egg weight, Quail Day and FCR

Feed Trial	R0	R1	R2	R3
Egg Weight (g)	10.39±0.29	10.42±0.24	10.42±0.28	10.53±0.13
Quail Day (%)	44.56±3.54	42.31±7.07	36.06±10.55	42.93±12.43
FCR	5.09±0.74	5.59±1.09	8.29±5.42	5.93±1.67

Caption: R0 = control diet without babadotan leaf meal; R1 = diet containing 1% babadotan leaf meal; R2 = diet containing 3% babadotan leaf meal; R3 = diet containing 5% babadotan leaf meal. The totals are standardized to 100% for consistency in formulation.

Egg Weight

The inclusion of babadotan leaf meal in the diet tended to increase egg weight numerically, although the effect was not statistically significant. As shown in Table 3, mean egg weight rose slightly from 10.39±0.29 g in the control treatment (R0) to 10.53±0.13 g in the 5% babadotan treatment (R3), while the intermediate treatments (R1 and R2) each recorded 10.42 g. This pattern indicates that babadotan leaf meal up to 5% did not adversely affect egg formation, yet the magnitude of change was too small to demonstrate a meaningful biological response under the present feeding conditions. The absence of significance is also consistent with the relatively similar nutrient composition among the experimental diets, particularly crude protein, which ranged only from 22.48% to 22.61%, suggesting that the basal nutrient supply remained essentially comparable across treatments. Under such conditions, the slight increase in egg weight may reflect only a limited contribution of the phytogenic compounds in babadotan rather than a strong nutritional or physiological effect on egg formation .

This finding is in line with the broader literature showing that phytogenic additives may improve egg weight under certain dietary and environmental conditions, but that the response is often inconsistent and highly dependent on additive type, inclusion level, and nutrient balance. Garcia et al. (2021) reported that *Moringa oleifera* leaf meal improved egg weight in Japanese quail, while Mustafa (2022), Kour et al. (2024), Pontes et al. (2024), and Barros et al. (2024) also described positive egg-weight responses to some phytogenic regimens. However, the synthesis of the supporting literature also emphasizes that evidence for *Ageratum conyzoides* specifically remains limited and inconclusive, so a clear egg-weight-promoting effect cannot yet be asserted with confidence. In addition, egg weight in quail is strongly influenced by age, dietary protein and mineral adequacy, genetics, and environmental temperature, all of which may exert a larger effect than the phytogenic inclusion itself (Tadesse, 2024; Mustafa, 2022; KARAKCI et al., 2022; Karásková et al., 2015; Khan et al., 2022; Garcia et al., 2021; Barros et al., 2024) . Thus, the present result suggests that babadotan leaf meal can be incorporated up to 5% without depressing egg weight, but it was not effective enough to produce a statistically significant improvement in this parameter under the experimental conditions used here .

Quail Day Production

Quail day production showed a declining trend with babadotan supplementation, although the differences among treatments were not statistically significant. The highest quail day value was observed in the control group (R0) at 44.56±3.54%, followed by R3 at 42.93±12.43%, R1 at 42.31±7.07%, and the lowest value in R2 at 36.06±10.55%. These data indicate that dietary inclusion of babadotan leaf meal did not improve the laying rate of Japanese quail during the observation period. The lower production in the supplemented groups may be associated with the fact that the nutrient profile of all diets remained relatively similar, so the addition of babadotan did not create a sufficiently strong nutritional advantage to enhance oviposition. Furthermore, the higher crude fiber content in diets containing babadotan leaf meal may have slightly limited nutrient utilization efficiency, although not to a statistically demonstrable extent .

The result contrasts with several reports showing that phytogenic feed additives can elevate hen-day egg production in laying quail, particularly when used at effective doses or under stress conditions. Mustafa (2022) found that oleobiotec supplementation improved egg production in Japanese quail, while KARAKCI et al. (2022), Pontes et al. (2024), and Barros et al. (2024) also reported beneficial effects of aromatic plant extracts, essential oil blends, and functional oils on laying performance. Garcia et al. (2021) similarly noted that leaf-based phytogenics such as *Moringa oleifera* may enhance production performance in some contexts. However, the literature also stresses that phytogenic responses are highly variable and depend on diet composition, heat stress, water intake, gut health, and the specific phytochemical profile of the additive. In the present study, the absence of a significant increase in quail day production suggests that babadotan leaf meal, despite its known bioactive compounds, did not sufficiently improve gut function or nutrient partitioning to stimulate a higher laying rate. Therefore, the dominant determinants of production may have remained the birds' age, physiological status, and the adequacy of the basal diet rather than the babadotan supplementation itself (Mustafa, 2022; KARAKCI et al., 2022; Pontes et al., 2024; Barros et al., 2024; Garcia et al., 2021; Karásková et al., 2015; Mnisi et al., 2022; Nurjanah et al., 2023) . Accordingly, these findings support the conclusion that babadotan leaf meal up to 5% did not significantly enhance quail day production in the early laying phase .

Feed Conversion Ratio

The feed conversion ratio tended to worsen as babadotan leaf meal was included in the diet, although the variation among treatments was not statistically significant. The control treatment (R0) showed the lowest and therefore most efficient FCR value at 5.09±0.74, followed by R1 at 5.59±1.09 and R3 at 5.93±1.67, while the highest and least efficient value was observed in R2 at 8.29±5.42. Since lower FCR values indicate better feed efficiency, these results suggest that babadotan supplementation did not improve the conversion of feed into egg output. The marked increase in FCR in R2 may indicate greater variability in feed utilization among birds in this treatment, which is also reflected by the large standard deviation. One possible explanation is that the inclusion of babadotan leaf meal slightly increased dietary crude fiber from 6.07% in R0 to 6.40% in R3, which may have reduced digestible nutrient availability and thereby limited efficiency of production. Because egg production also tended to be lower in the supplemented groups, feed intake was not translated into proportionally higher egg output, resulting in poorer FCR values overall .

This result differs from some reports in the literature where phytogenic additives improved feed efficiency in laying quail. Nurjanah et al. (2023) found that chaya leaf infusion reduced FCR, while Dosoky et al. (2021) and several studies on essential oils and aromatic extracts also observed improved feed efficiency under certain feeding regimens. Moringa-based supplementation has likewise been associated with favorable feed efficiency in some studies, although the response is not always consistent (Garcia et al., 2021; Khan et al., 2021; Arif et al., 2022). The literature synthesis further indicates that FCR responses to herbal additives depend on many interacting factors, including the energy–protein balance of the diet, crude fiber level, delivery route, gut health, and environmental stress. Phytogenic additives may improve FCR when they enhance digestibility, intestinal morphology, antioxidant status, or egg mass output, but these benefits are not universal across all plant species or inclusion rates. In the present experiment, babadotan leaf meal did not produce such an efficiency gain, suggesting that its bioactive properties were insufficient to overcome the modest increase in fiber content or to stimulate better nutrient utilization under the existing diet formulation. Thus, although babadotan leaf meal did not significantly impair bird health, it also did not confer a practical advantage in feed efficiency (Nurjanah et al., 2023; Dosoky et al., 2021; KARAKCI et al., 2022; Khan et al., 2022; El-Sabrout et al., 2023; Barros et al., 2024; Kour et al., 2024; Garcia et al., 2021) . Overall, these findings indicate that supplementation of babadotan leaf meal up to 5% is not effective for improving feed conversion ratio in laying Japanese quail and tends instead to maintain or slightly reduce feeding efficiency relative to the control diet .

CONCLUSION AND IMPLICATIONS

Supplementation of babadotan (*Ageratum conyzoides*) leaf meal at 1%, 3%, and 5% in the diets of laying Japanese quail did not significantly affect egg weight, quail day production, or feed conversion ratio. Although egg weight tended to increase slightly at the 5% level, the control group showed the highest quail day production and the most efficient FCR, indicating that babadotan leaf meal did not improve overall laying performance under the conditions of this study . These results suggest that the similar nutrient composition of the experimental diets and the modest increase in crude fiber with babadotan inclusion may have limited any productive response. Therefore, babadotan leaf meal can be included up to 5% without negative effects, but it cannot yet be recommended as an effective feed additive to enhance egg productivity in Japanese quail .

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