

Productive response of the Japanese quail (*Coturnix coturnix japonica*) to different natural growth promoters in the breeding and development stageResposta produtiva da codorna japonesa (*Coturnix coturnix japonica*) a diferentes promotores de crescimento natural na fase de reprodução e desenvolvimentoRespuesta productiva de la codorniz japonesa (*Coturnix coturnix japonica*) a diferentes promotores naturales del crecimiento en la fase de cría y desarrollo**Verónica de los Ángeles Bonifaz Ramos**<https://orcid.org/0009-0000-6333-0187>University Professor and Researcher at Faculty of Agricultural Sciences, Universidad Técnica de Babahoyo, Ecuador
veronica.bonifaz@gmail.com (correspondence)**Sara Susana Sánchez Moran**<https://orcid.org/0000-0002-7702-986X>

University Professor and Researcher at Faculty of Agricultural Sciences, Universidad Técnica de Babahoyo, Ecuador

Ketty Beatriz Murillo Cano<https://orcid.org/0000-0001-7935-5995>

University Professor and Researcher at Faculty of Agricultural Sciences, Universidad Técnica de Babahoyo, Ecuador

Lino Fabián Velasco Espinoza<https://orcid.org/0000-0003-3600-652X>

University Professor and Researcher at Faculty of Agricultural Sciences, Universidad Técnica de Babahoyo, Ecuador

ABSTRACT

This study evaluated the productive response of Japanese quail (*Coturnix coturnix japonica*) to natural growth promoters during male breeding and development stages. A completely randomized design was used with three treatments and a control group, each with three replicates, totaling 15 experimental units and 180 birds, starting at 8 days old for a duration of 7 weeks. The treatments were: T0 (Commercial Feed + Water ad libitum); T1 (Commercial Feed + 10 g Ginger/kg feed + Water ad libitum); T2 (Commercial Feed + 10 g Cinnamon/kg feed + Water ad libitum); and T3 (Commercial Feed + 10 g Oregano/kg feed + Water ad libitum). Variables measured included initial weight, final weight, weight gain, feed intake, feed conversion ratio, carcass yield, mortality, and cost-benefit ratio. Data were analyzed using Tukey's test at $P < 0.0005$. T1 showed the best results with a final weight of 149.76 g, weight gain of 129.50 g, and a cost-benefit ratio of \$2.74. T2 followed with a final weight of 139.74 g, weight gain of 120.69 g, and a cost-benefit ratio of \$2.27. T3 had similar outcomes to T2, with a final weight of 138.6 g, weight gain of 118.45 g, and a cost-benefit ratio of \$2.25. The control group, T0, recorded the lowest performance, with a final weight of 105.8 g, weight gain of 85.32 g, and a cost-benefit ratio of \$2.2. These results suggest that natural growth promoters, especially ginger, significantly improve the productive performance and economic efficiency of Japanese quail during their growth stages.

Keywords: Japanese quail, natural growth promoters, productive performance, breeding, development, feed conversion, carcass yield, cost-benefit analysis.

RESUMO

Este estudo avaliou a resposta produtiva de codornizes japonesas (*Coturnix coturnix japonica*) a promotores de crescimento naturais durante as fases de criação e desenvolvimento em machos. Um delineamento inteiramente casualizado foi utilizado com três tratamentos e um grupo controle, cada um com três réplicas, totalizando 15 unidades experimentais e 180 aves, começando aos 8 dias de idade por 7 semanas. Os tratamentos foram: T0 (Ração Comercial + Água ad libitum); T1 (Ração Comercial + 10 g de Gengibre/kg de ração + Água ad libitum); T2 (Ração Comercial + 10 g de Canela/kg de ração + Água ad libitum); e T3 (Ração Comercial + 10 g de Orégano/kg de ração + Água ad libitum). As variáveis medidas incluíram peso inicial, peso final, ganho de peso, consumo de ração, conversão alimentar, rendimento de carcaça, mortalidade e relação custo-benefício. Os dados foram analisados usando o teste de Tukey com $P < 0.0005$. O T1 mostrou os melhores resultados com peso final de 149.76 g, ganho de peso de 129.50 g e uma relação custo-benefício de \$2.74. O T2 seguiu com peso final de 139.74 g, ganho de peso de 120.69 g e uma relação custo-benefício de \$2.27. O T3 teve resultados semelhantes ao T2, com peso final de 138.6 g, ganho de peso de 118.45 g e uma relação custo-benefício de \$2.25. O grupo controle, T0, registrou o desempenho mais baixo, com peso final de 105.8 g, ganho de peso de 85.32 g e uma relação custo-benefício de \$2.2. Esses resultados sugerem que os promotores de crescimento naturais, especialmente o gengibre, melhoram significativamente o desempenho produtivo e a eficiência econômica das codornizes japonesas durante suas fases de crescimento.

Palavras-chave: codornizes japonesas, promotores de crescimento naturais, desempenho produtivo, criação, desenvolvimento, conversão alimentar, rendimento de carcaça, análise custo-benefício.

RESUMEN

Este estudio evaluó la respuesta productiva de codornices japonesas (*Coturnix coturnix japonica*) a promotores de crecimiento naturales durante las etapas de cría y desarrollo en machos. Se utilizó un diseño completamente aleatorizado con tres tratamientos y un grupo de control, cada uno con tres réplicas, totalizando 15 unidades experimentales y 180 aves, comenzando a los 8 días de edad durante 7 semanas. Los tratamientos fueron: T0 (Alimento Comercial + Agua ad libitum); T1 (Alimento Comercial + 10 g de Jengibre/kg de alimento + Agua ad libitum); T2 (Alimento Comercial + 10 g de Canela/kg de alimento + Agua ad libitum); y T3 (Alimento Comercial + 10 g de Orégano/kg de alimento + Agua ad libitum). Las variables medidas incluyeron peso inicial, peso final, ganancia de peso, consumo de alimento, relación de conversión alimenticia, rendimiento de la canal, mortalidad y relación costo-beneficio. Los datos se analizaron utilizando la prueba de Tukey con $P < 0.0005$. T1 mostró los mejores resultados con un peso final de 149.76 g, ganancia de peso de 129.50 g y una relación costo-beneficio de \$2.74. T2 siguió con un peso final de 139.74 g, ganancia de peso de 120.69 g y una relación costo-beneficio de \$2.27. T3 tuvo resultados similares a T2, con un peso final de 138.6 g, ganancia de peso de 118.45 g y una relación costo-beneficio de \$2.25. El grupo de control, T0, registró el rendimiento más bajo, con un peso final de 105.8 g, ganancia de peso de 85.32 g y una relación costo-beneficio de \$2.2. Estos resultados sugieren que los promotores de crecimiento naturales, especialmente el jengibre, mejoran significativamente el rendimiento productivo y la eficiencia económica de las codornices japonesas durante sus etapas de crecimiento.

Palabras clave: codornices japonesas, promotores de crecimiento naturales, rendimiento productivo, cría, desarrollo, conversión alimenticia, rendimiento de la canal, análisis costo-beneficio.

ARTICLE HISTORY**Received:** 11-01-2024**Revised Version:** 25-04-2024**Accepted:** 19-07-2024**Published:** 01-08-2024**Copyright:** © 2024 by the authors**License:** CC BY-NC-ND 4.0**Manuscript type:** Article**ARTICLE INFORMATION****Science-Metrix Classification (Domain):**

Natural Sciences

Main topic:Breeding of Japanese quail (*Coturnix coturnix japonica*)**Main practical implications:**

This study demonstrates that ginger significantly enhances the growth and economic efficiency of Japanese quail, suggesting its potential as a valuable natural growth promoter.

Originality/value:

This research has in its originality to bring a sustainable and cost-benefit perspective, specifically for developing countries with the impetus to raise their food sovereignty. In this regard, the research discusses the efficacy of natural growth promoters, specifically ginger, in improving the productive performance and cost efficiency of Japanese quail.

INTRODUCTION

Coturnix coturnix japonica or also called Japanese common quail, is native to the country of Japan appearing between the first decade of the last century, where it was rapidly domesticated based on its eggs and mainly for its protein-rich meat (Galindez, 2019). The quail species (*C. coturnix japonica*) can produce approximately 300 eggs per female per year. Its global impact has two basic fundamentals: its hardiness and high egg production (Grimaldos, 2020). In the international context, recent studies have delved into various aspects of enhancing the productivity and reproductive health of Japanese quail (*Coturnix coturnix japonica*) through dietary interventions and environmental modifications. Khan et al. (2024) investigated the effects of dietary probiotics on male quail, highlighting the positive impact on testicular development, steroidal hormones, and oxidative stress markers, ultimately improving fertility via gut microbiota modulation. Similarly, Kamel et al. (2021) explored the dietary inclusion of pomegranate peel powder, revealing significant improvements in growth performance, antioxidant properties, and hepatic gene expression in Japanese quail, without adversely affecting carcass quality.

Bobadilla-Mendez et al. (2016) focused on the influence of different light sources on reproductive anatomy and physiology, finding that white LED bulbs advanced sexual maturity and improved reproductive organ development. Lukanov and Pavlova (2020) reviewed the morphological and productive changes in domesticated Japanese quail, noting significant enhancements in weight, egg production, and reproductive behaviors compared to their wild counterparts.

Moreover, Abdelfattah et al. (2023) demonstrated the beneficial effects of ginger roots on male reproductive performance, showing dose-dependent improvements in sperm quality, testosterone levels, and seminiferous tubule development. Hegab and Hanafy (2019) emphasized the importance of egg weight in embryonic development and hatchability, recommending larger egg sizes for better reproductive outcomes.

In the realm of dietary supplementation, Abd El-Hack et al. (2024) evaluated the effects of microalgae levels on quail performance, fertility, and biochemical parameters, concluding that certain supplements can mitigate the toxic impacts of environmental contaminants. Bello et al. (2014) assessed the repercussions of di(n-butyl) phthalate exposure on testicular function, noting dose-dependent disruptions in steroidogenesis and testicular architecture. Lastly, Khoobbakht et al. (2020) investigated the role of zinc supplementation in sexual development and IGF gene expression, finding that zinc-methionine was particularly effective in enhancing testicular growth and reproductive hormone levels. Due to the hardiness and great adaptability of quail to temperate and warm climates, it has been a bird that has attracted the attention of poultry producers worldwide and this translates into medium and large-scale production in different parts of the planet.

With respect to a national context, in Ecuador, the largest technical and non-technical production is in the tropical zone of the country, i.e. the Ecuadorian coast (Sagñay, 2021). Also in a national context, quail breeding has gained ground in poultry farming, especially in temperate and warm areas of the country. It has been more popular among small and medium-sized producers because it requires less space, ease of environmental changes, low feed consumption and high egg production. Also thanks to the fact that its meat is a good source of food both in traditional and gourmet food (Buenaño, 2018).

The increase of quail production in Ecuador is due to production benefits such as: precocity of the bird; low feed consumption compared to other production birds (chickens, turkeys, etc.); short space required for production; hardiness to diseases and climatic changes; high nutritional value of meat and eggs. However, the most striking feature is its economic profitability, which is increasingly attracting the attention of small, medium and large producers to venture into this branch of production (Martínez, 2023). In itself, quail farming in Ecuador began to boom in the 1990s, starting with small productions around the country, but currently quail farming has been technified and has high value productions in provinces such as: Cañar, Guayas, Imbabura, Pichincha and Tungurahua (Pincay, 2023).

In Ecuador, quail production is subject to specific regulations and standards that seek to guarantee the quality of poultry products, animal welfare and food safety. These regulations establish a series of parameters and requirements that producers must comply with in order to operate within the legal framework and contribute to the sustainable development of the poultry sector in the country (Medina-Hernández, 2021).

One of the main aspects regulated is biosecurity in quail breeding and production facilities. This includes measures to prevent the spread of poultry diseases, such as the implementation of access control systems, adequate disinfection, and proper handling of poultry waste and by-products. In addition, producers must comply with hygiene and sanitation standards at all stages of production, from the reception of chicks to the processing of final products (Rúales, 2020).

Proper feeding and nutrition are fundamental aspects in the care of quails, as they significantly influence their health, development and production, especially in the case of those destined for poultry production (Jurado, 2017). Spices are normally used for culinary purposes, however, they also have properties that are useful for health, such as: antioxidant, anti-inflammatory and antimicrobial. In this research the use of three types of spices was implemented: Oregano (*Origanum*

vulgare); Ginger (*Zingiber officinale*) and Cinnamon (*Cinnamomum verum*). Among the main qualities of oregano is mainly antioxidant such as tocopherols, carotenoids, ascorbic acid and phenolic compounds. Thanks to this, oregano helps in the prevention of cardiovascular diseases and diabetes, in addition to providing a great source of vitamin C. As for its antimicrobial function, activity against major negative bacteria such as *Salmonella typhimurium*, *Escherichia coli*, *Klebsiella pneumoniae*, *Yersinia enterocolitica* and *Monocytogenes* and *Bacillus subtilis* is reported (Arcila et al., 2019).

Ginger, scientifically known as *Zingiber officinale*, is a plant widely recognized for its medicinal properties in humans. However, its use in birds has also been the subject of study and application in avian veterinary medicine (Acosta, 2020). It is important to note that, although ginger can offer several health benefits to birds, its use should be moderate and under the supervision of an avian veterinarian. In addition, the possibility of adverse reactions or interactions with other medications that the bird may be taking should be taken into account (Pazmiño, 2020).

Ginger due to its spicy and strong flavor has an antiemetic function, according to some research it helps to control nausea, dizziness, vomiting, diarrhea and stomach pain (gastro-digestive). Another important property is immunological, due to its concentrations of iron, vitamin C and terpenes, making it an excellent anti-flu and antitussive, circulation promoter and detoxifier. (Acosta, 2020).

Cinnamon, a spice derived from the bark of the *Cinnamomum verum* or *Cinnamomum cassia* tree, is known for its various medicinal uses in humans. However, its application in birds has also been the subject of interest in the field of avian veterinary medicine (Sulca et al., 2019). Cinnamon has been used as a neurotherapeutic agent as it has analgesic qualities for abdominal pain and spasms, also according to Ayurvedic medicine suggests that it has antidiarrheal, antiemetic, antiarthritic, antifatulent and stimulant properties. In addition, it usually has antibacterial properties in terms of urinary infections and control of cardiovascular pathologies (León, 2023).

Oregano, an aromatic herb commonly used in cooking, also has a number of medicinal properties that may be beneficial to birds. Although research on the use of oregano in birds is limited compared to other animals, there are some medical generalities that may apply (Arcila et al., 2019).

In this sense, the objective of the research is to determine the productive response of the Japanese quail (*Coturnix coturnix japonica*) to different natural growth promoters at the breeding and development stage in males.

METHODOLOGY

The research project was developed within the Research Seed Program of the Veterinary Medicine Faculty of Agricultural Sciences of the Technical University of Babahoyo, located in the Province of Los Ríos Canton Babahoyo, Ecuador, within the project "Evaluation of the Productive Characteristics of quail (*C. coturnix*) in the Tropics". Code PSI-UTB-004-2023 approved by the Research Unit in the third call for proposals 2023. In this research the Completely Randomized Experimental Design (C.R.D.) was used, with three treatments and three replicates against a control treatment, applying three treatments against a control treatment with three replicates per treatment with a total of 15 Experimental Units, which consisted of 12 Animal Units with a total of 180 animal units, of 8 days of age, which underwent 7 weeks of study.

Table 1. Distribution of the sample

TREATMENT	DIET COMPOSITION
T0	Balanced + water at will.
T1	Balance + 10 g of ginger (<i>Zingiber officinale</i>) per 1 kg of balance + water at will.
T2	Balanced 10 g of cinnamon (<i>Cinnamomum verum</i>) per 1 kg of balanced + water at will.
T3	Balance 10 g of oregano (<i>Origanum vulgare</i>) per 1 kg of balance + water at will.

Source: Prepared by the authors using the research data.

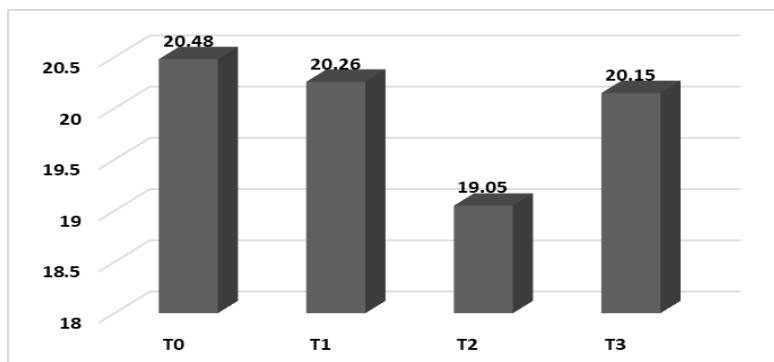
In this research we applied the experimental method and evaluated the cause-effect relationships between variables through the manipulation and control of conditions, since this allowed us to establish the variables and delimit the relationship between them in order to explore, understand and explain phenomena of the results obtained in the study. The techniques employed in this study focused on the observation and systematic recording of variables related to the productive characteristics of the quails. In addition, sampling techniques were used to collect data on bird performance and behavior in response to different feeding treatments. Furthermore, all elements related to the ethical aspect of the research were adhered to, and international protocols for animal experimentation were appropriately observed.

Statistical techniques for the analysis of the data collected were used for their tabulation and their results allow us to establish solid conclusions based on the study. In the data processing stage, a careful and structured procedure was followed. Beginning with the collection of data using the techniques and instruments mentioned above during the experimental period. These data were organized in a systematic way, assigning numerical values and categories according to the variables of interest. Once collected and organized, they were entered into an electronic database using specialized software. This process was carried out meticulously to guarantee the consistency and accuracy of the data, avoiding possible errors in the entry of information. Subsequently, a thorough verification of the data was carried out to identify and correct any errors or inconsistencies that may have arisen during data collection or entry. This step is essential to ensure the integrity of the information. With the data verified and organized, appropriate statistical techniques were applied to explore the variability and relationships between variables in the different treatment groups. This statistical analysis provided key information on the effects of the treatments on the productive characteristics of the quail. Finally, the results obtained were carefully interpreted to derive meaningful conclusions. This data processing process ensured the quality and validity of the information, allowing an accurate assessment of treatment effects and supporting conclusions based on the study.

RESULTS AND DISCUSSION

With respect to the initial weight variable, no greater relevance was obtained with respect to the treatments, that is to say, all treatments began or started with almost the same significance ($p > 0.05$) between initial weight treatments, with a coefficient of variation of 5.94; an even result was obtained between T0, T1, T2 and T3 with an average weight of 19.985 g. With this data, it was possible to plan and divide the animal units into even groups and to plan their diets with greater accuracy and to have a weight record prior to the treatments with natural promoters.

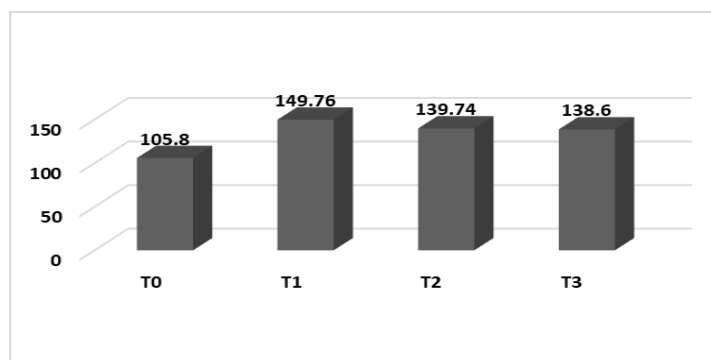
Figure 1. Initial weight (g)



Note. Prepared by the authors using the research data.

Regarding the variable of final weight prior to carcass in each treatment, there were relatively significant differences between each treatment with a significance equivalent to ($p < 0.0001$), with a coefficient of variation of 1.80. This allowed mentioning that the treatment that obtained the best final weight was T1 with 149.76 g, decreasing to T2: 139.74 g; T3: 138.6 and T0 with 105.8 g, as shown in Figure 2.

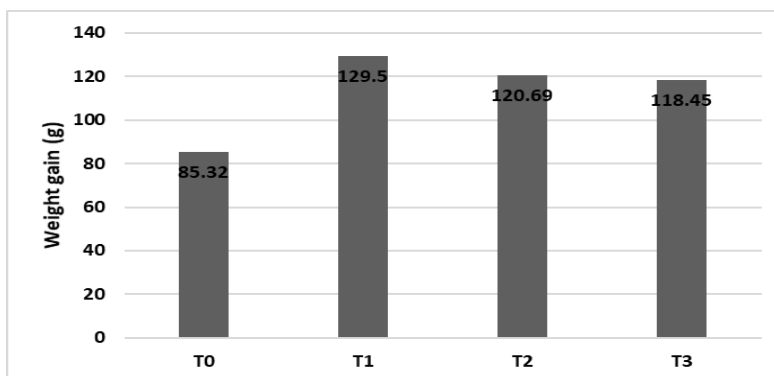
Figure 2. Final weight (g)



Note. Prepared by the authors using the research data.

Regarding the variable of final weight prior to carcass in each treatment, there were relatively significant differences between each treatment with a significance equivalent to ($p < 0.0001$), with a variation coefficient of 1.80. This allowed mentioning that the treatment that obtained the best weight gain was T1 with 129.5 g, decreasing to T2: 120.69 g; T3: 118.45 and T0 with 85.32 g, as shown in Figure 3.

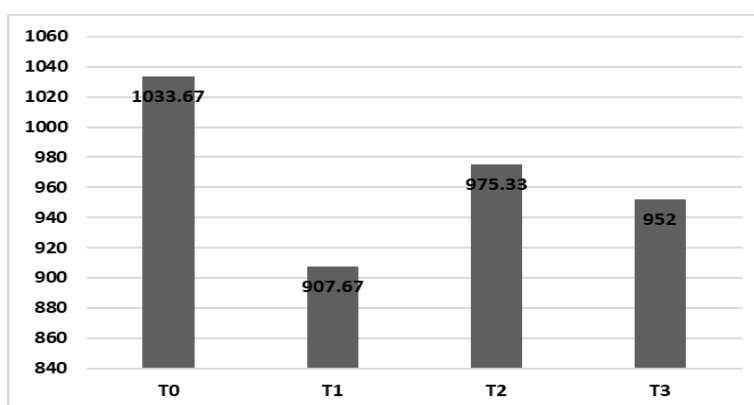
Figure 3. Weight gain (g)



Note. Prepared by the authors using the research data.

With respect to feed consumption per experimental unit, the research established that there is a notable difference between treatments ($p > 0.0111$), with a coefficient of variation of 3.47. The highest results were from treatment T0: 1033.67 g, decreasing to T2: 975.33 g; followed by T3: 952 g and finally by T1 with 907.67 g as shown in Figure 4.

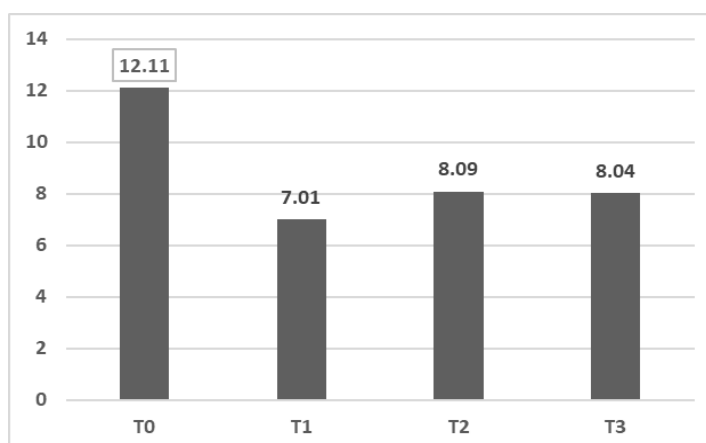
Figure 4. Feed consumption (g)



Note. Prepared by the authors using the research data.

Regarding the feed conversion per experimental animal unit, the research established that there is a notable difference between treatments ($p < 0.0001$), with a coefficient of variation of 3.73. The highest results were from treatment T0: 12.11 g, decreasing to T2: 8.09 g; followed by T3: 8.04 g and finally by T1 with 7.01 g as shown in Figure 5.

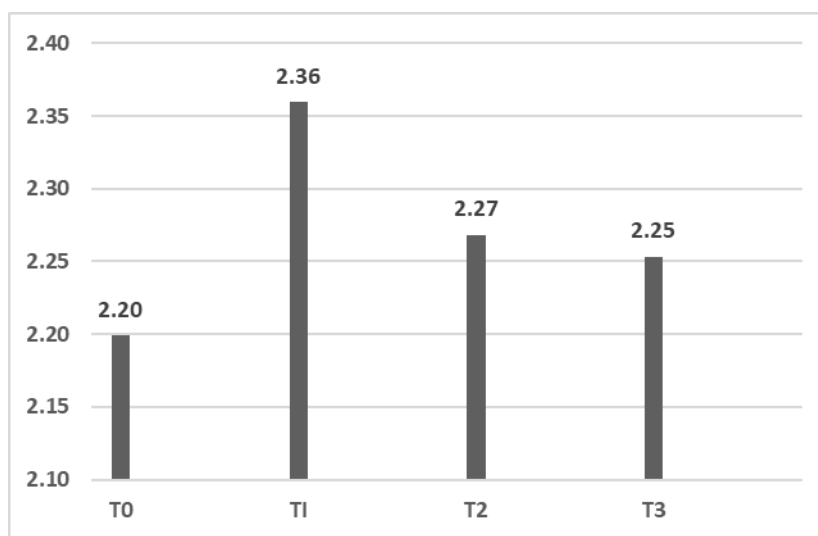
Figure 5. Feed conversion



Note. Prepared by the authors using the research data.

Regarding the cost benefit per experimental animal unit according to the research that established that there is a notable difference between treatment ($p > 0.05$), with a coefficient of variation of 3. The highest results were from the treatment, that is, for each 1 U.S.D. invested the following gains were obtained T1: 2.37 USD, decreasing to T2: 2.27 USD; followed by T3: 2.25 USD and finally by T1 with 2.20 USD, as shown in Figure 6.

Figure 6. Cost Benefit Analysis



Note. Prepared by the authors using the research data.

Regarding the organoleptic properties, the taste of the quail meat in most of the treatments was pleasant to most palates; regarding the color of the quail meat in most of the treatments, the meat coloration was pink for T1 (ginger), an intense red for T2 (cinnamon), a pale red in T3 (oregano) and a pale pink in T0; As for the texture of the quail meat in the majority of treatments, the meat of treatment 1 (ginger) was softer or softer, followed by the meat of treatment 2 (cinnamon) and treatment 3 (oregano), compared to the treatment.

Discussion

Within the productive behavior parameters obtained from the implementation of different natural growth promoters in the breeding and development stage for male Japanese quail were positive in the 3 different types of treatment, due to the qualities and palatability obtained by adding Ginger, Oregano and Cinnamon to the diet, giving excellent results compared to the control treatment, which also helps to use materials easy to acquire in the area and thus leaving aside the dependence on products or supplements from other regions, thus empowering small and medium producers. (Ruales, 2007).

Regarding the productive parameters obtained in the final weight, T1 with 149.76 g decreasing to T2: 139.74 g; T3: 138.6 and T0 with 105.8 g, which clearly shows how the supplementation was done. In comparison with similar research carried out by Rodriguez (2022) with respect to the productive behavior of quail, weights around 179.67 g were obtained when supplementing with shrimp head meal feed.

In relation to the organoleptic characteristics, it is mentioned that they were obtained in most of the treatments applied in the study, so it is possible to suggest the use of the same in quail production. Another important parameter to mention is weight gain, which showed the following results: the treatment that obtained the best weight gain was T1 with 129.5 g, decreasing to T2:120.69 g; T3:118.45 and T0 with 85.32 g. While in comparison, according to (Rodriguez, 2022) 4 % more weight gain was obtained compared to similar treatments with natural promoters.

The present study's findings align with the existing body of literature that underscores the efficacy of natural growth promoters in enhancing the productive performance of Japanese quail. The superior results observed with ginger supplementation (T1) are consistent with Abdelfattah et al. (2023), who reported significant improvements in sperm quality, testosterone levels, and reproductive organ development with ginger root inclusion in quail diets. This study further validates the potential of ginger as a potent growth promoter, especially in enhancing final weight and cost-benefit ratios.

Comparatively, the results with cinnamon and oregano (T2 and T3) supplementation also demonstrated notable improvements in weight gain and cost efficiency, corroborating Kamel et al. (2021), who highlighted the antioxidant and growth-promoting properties of pomegranate peel powder. Both studies emphasize the role of natural dietary additives in enhancing growth performance without compromising carcass quality. The control group (T0) in our study, which yielded the lowest final weight and weight gain, mirrors the findings of Bello et al. (2014), where the absence of beneficial dietary

interventions led to suboptimal growth and reproductive outcomes. This highlights the necessity of incorporating effective growth promoters to achieve optimal productivity in Japanese quail.

Furthermore, the results related to feed conversion and carcass yield align with the outcomes reported by Bobadilla-Mendez et al. (2016), who demonstrated the significant impact of environmental factors, such as lighting, on reproductive performance and overall productivity. While our study focused on dietary interventions, the parallel improvements in productive parameters emphasize the interconnectedness of environmental and dietary enhancements.

CONCLUSIONS

According to the results obtained in the research, it is concluded that thanks to the implementation of natural promoters in the diet of male quails in the stage of breeding and development for meat production, an improvement in productive behavior was observed, including aspects such as weight gain, final weight, profit/cost and thanks to the implementation of ginger, cinnamon and oregano, showing very positive results, mainly with treatment 1 (T1) with ginger, final weight, profit/cost and thanks to the implementation of ginger, cinnamon and oregano, the results were quite positive, mainly with treatment 1 (T1) with ginger, with a composition of 10 g of powdered ginger in each 1000 g of quail feed + water at will.

In addition, it was obtained that within the benefit/cost of the 4 treatments used, the most profitable was treatment 1 with equivalent benefits for each 1 U.S.D invested, in which a profit of 2.78 U.S.D is obtained, expressing at an economic level to be the most profitable.

Main limitations and future research

Theoretical and methodological limitations of the current study include the limited scope of natural growth promoters tested, the relatively small sample size, and the short duration of the study period. These constraints may affect the generalizability and robustness of the findings. Additionally, the study's focus on male Japanese quails without considering the potential interactions with females or the effects of these growth promoters on other physiological aspects limits a comprehensive understanding of their overall impact. Future research should expand the variety of natural growth promoters evaluated, increase the sample size, and extend the duration of the study to validate and enhance these findings. Moreover, investigating the interactions between different genders, environmental conditions, and other physiological parameters such as immune response, stress resistance, and reproductive performance could provide a more holistic view of the benefits and limitations of natural growth promoters in poultry.

REFERENCES

- Abd El-Hack, M. E., Majrashi, K. A., Fakiha, K. G., Roshdy, M., Kamal, M., Saleh, R. M., ... & Alagawany, M. (2024). Effects of varying dietary microalgae levels on performance, egg quality, fertility, and blood biochemical parameters of laying Japanese quails (*Coturnix coturnix japonica*). *Poultry Science*, 103(4), 103454. <https://doi.org/10.3382/ps/pey186>
- Abdelfattah, M. G., Hussein, M. T., Ragab, S. M., Khalil, N. S. A., & Attaai, A. H. (2023). The effects of Ginger (*Zingiber officinale*) roots on the reproductive aspects in male Japanese Quails (*Coturnix coturnix japonica*). *BMC Veterinary Research*, 19(1), 34. <https://doi.org/10.1186/s12917-023-03576-6>
- Alvarado Cuji, L. M., & Naula Shucad, M. R. (2021). Análisis de los principios activos y sus aplicaciones industriales de la canela (*Ocotea quixos*) y flor de jamaica (*Hibiscus Sabdariffa*) de la amazonía (Bachelor's thesis, Universidad Estatal Amazónica).
- Arcila, C., Loarca, G., Lecona, S., & González de Mejía, E. (2019). El orégano: propiedades, composición y actividad biológica de sus componentes. *Archivos Latinoamericanos de Nutrición*, 54(1), 100-111.
- Bello, U. M., Madekurozwa, M. C., Groenewald, H. B., Aire, T. A., & Arukwe, A. (2014). The effects on steroidogenesis and histopathology of adult male Japanese quails (*Coturnix coturnix japonica*) testis following pre-pubertal exposure to di (n-butyl) phthalate (DBP). *Comparative Biochemistry and Physiology Part C: Toxicology & Pharmacology*, 166, 24-33. <https://doi.org/10.1016/j.cbpc.2014.06.005>
- Bobadilla-Mendez, M. F., Rojas-Granados, C. P., Andrade, E. F., Retes, P. L., Ferreira, L. G., Alvarenga, R. R., ... & Zangeronimo, M. G. (2016). Effect of different light sources on reproductive anatomy and physiology of Japanese quail (*Coturnix coturnix japonica*). *Animal reproduction science*, 168, 50-56. <https://doi.org/10.1016/j.anireprosci.2016.02.025>
- Buenaño, J., Nuñez, P., Barros, M., Rosero, M., Lozada, E., Guishca, C., & Zurita, H. (2018). Efecto de la inclusión de Azolla en la dieta de codornices japonesas sobre el consumo voluntario, digestibilidad aparente y producción de huevos. *Revista de Investigaciones Veterinarias del Perú*, 29(1), 161-168.
- Galíndez, R., De Basilio, V., Martínez, G., Vargas, D., Uztariz, E., & Mejía, P. (2019). *Evaluación de la fertilidad y eclosión en la codorniz japonesa*. *Zootecnia Tropical*, 27(1), 007-018.
- Grimaldos, D. (2020). Guide for the production of eggs and quail at the industrial level. Retrieved from: <https://repository.ucc.edu.co/server/api/core/bitstreams/7f3cd388-29ba-49e3-9941-e7442820f221/content>
- Hegab, I. M., & Hanafy, A. M. (2019). Effect of egg weight on external and internal qualities, physiological and hatching success of Japanese quail eggs (*Coturnix coturnix japonica*). *Brazilian Journal of Poultry Science*, 21, eRBCA-2018. <https://doi.org/10.1590/1806-9061-2018-0777>

Jurado, R. (2017). Comportamiento productivo y calidad de huevo de codornices en postura alimentadas con dietas suplementadas con complejo enzimático comercial (Thesis, National Agrarian University La Molina). 92 p.

Kamel, E. R., Shafik, B. M., Mamdouh, M., Elrafaay, S., & Abdelfattah, F. A. I. (2021). Response of two strains of growing Japanese quail (*Coturnix Coturnix Japonica*) to diet containing pomegranate peel powder. *Tropical Animal Health and Production*, 53, 1-11. <https://doi.org/10.1007/s11250-021-02987-7>

Khan, A., Kango, N., & Srivastava, R. (2024). Impact of dietary probiotics on the immune and reproductive physiology of pubertal male Japanese Quail (*Coturnix coturnix japonica*) administered at the onset of pre-puberty. *Probiotics and Antimicrobial Proteins*, 1-19. <https://doi.org/10.1007/s12602-023-10209-9>

Khoobbakht, Z., Mehr, M. R. A., Mohammadi, M., Mohammadghasemi, F., & Sohani, M. M. (2020). Supplementation of various zinc sources modify sexual development and testicular IGF family gene expression in pre-pubertal male Japanese quail. *Research in veterinary science*, 130, 87-92. <https://doi.org/10.1016/j.rvsc.2020.03.004>

León, V. (2023). Estudio de adaptación de codornices (*Coturnix coturnix*) en zonas tropicales de Macas, Morona Santiago, mediante suplementación vitamínica (Graduate thesis, Escuela Superior Politécnica de Chimborazo). 94 p.

Lukanov, H., & Pavlova, I. (2020). Domestication changes in Japanese quail (*Coturnix japonica*): a review. *World's Poultry Science Journal*, 76(4), 787-801. <https://doi.org/10.1080/00439339.2020.1823303>

Martínez, C. (2023). Engorde de la codorniz (*Coturnix coturnix japónica*) sin Sexar con tres promotores de crecimiento en la zona de Mocache. Quevedo. UTEQ. 79 p. Retrieved from: <https://repositorio.uteq.edu.ec/items/4f20f3b4-01cf-425b-a957-85a119626a4a>

Medina-Hernández, E. J., Guzmán-Aguilar, D. S., Muñiz-Olite, J. L., & Siado-Castañeda, L. R. (2023). The current status of the sustainable development goals in the world. *Development Studies Research*, 10(1), 2163677.

Pazmiño. (2020). Influencia de las horas luz en la producción de huevos de codorniz (*Coturnix coturnix japónica*) en la Parroquia Ascázubi, Cayambe – Ecuador (Tesis de grado, Universidad Politécnica Salesiana, Ecuador). 110 p.

Pincay, N. (2023). Inclusión del lodo de palma en la dieta de codornices machos (*Coturnix coturnix*) en etapa de crecimiento, engorde y finalización (Thesis, Universidad Técnica de Babahoyo, Ecuador). 85 p.

Ruales, D. (2007). Effect of the addition of steroidal saponins in the diet of laying quail (*Coturnix coturnix japonica*). Retrieved from: <https://repositorio.utn.edu.ec/handle/123456789/181>.

Sagñay. (2021). Productive potential of the Japanese quail (*Coturnix coturnix japonica*) in Ecuador. Escuela Superior Politécnica de Chimborazo. Riobamba.

Sulca A., Figueroa T., & Carcelén C. (2019). Evaluación de los parámetros productivos de codornices, variedad japonesa (*Coturnix coturnix japonica*) provenientes de tres planteles reproductores de Lima. *Revista De Investigaciones Veterinarias Del Perú*, 11(2), 149-151. <https://doi.org/10.15381/rivep.v11i2.7354>

Contribution of each author to the manuscript:

Task	% of contribution of each author			
	A1	A2	A3	A4
A. theoretical and conceptual foundations and problematization:	25%	25%	25%	25%
B. data research and statistical analysis:	25%	25%	25%	25%
C. elaboration of figures and tables:	25%	25%	25%	25%
D. drafting, reviewing and writing of the text:	25%	25%	25%	25%
E. selection of bibliographical references	25%	25%	25%	25%
F. Other (please indicate)	-	-	-	-

Indication of conflict of interest:

There is no conflict of interest

Source of funding

There is no source of funding

Acknowledgments

There is no acknowledgment