Volume 12 Nomor 01, Juni 2024
https://doi.org/10.31949/Agrivet/v12i1.9425
E-ISSN : 2541-6154 P-ISSN: 2354-6190

The Impact of *Pediococcus acidilactici* BK01 Supplementation on Production Performance and Quality of Japanese Quail Eggs

Ade Rakhmadi*, Ade Sukma, Indri Juliyarsi, Sri Melia, Ely Febriyanti, Rizki Dwi Setiawan

Department of Animal Products Technology, Faculty of Animal Science,
Universitas Andalas, Padang 25163, Indonesia
*Corresponding author: arakhmadi@ansci.unand.ac.id

ABSTRACT

Probiotic supplementation in feed is currently under extensive research and development, particularly to improve egg production performance and enhance the quality of quail eggs. This study aimed to determine the effects of *Pediococcus acidilactici* BK01 supplementation on production performance, weight, fat, and cholesterol content of Japanese quail (*Coturnix japonica*) eggs. This study used four treatments and probiotic supplementation was performed using drinking water at four different concentrations (0, 1, 2, 3%). The supplementation of *Pediococcus acidilactici* BK01 demonstrated a significant difference ($P<0.05$) in both egg production and cholesterol content, yet did not yield a significant difference ($P>0.05$) in egg weight and lipid content. *Pediococcus acidilactici* BK01 supplementation at concentrations of 2% and 3% resulted in an increase in egg production from 60.85% to 84.52% and led to a reduction in cholesterol content by more than 50% (from 215.43 to 98.57 mg/dL) compared to the control group. Consequently, the administration of the probiotic *Pediococcus acidilactici* BK01 up to a concentration of 3% influenced on egg production and egg cholesterol content in Japanese quail.

Keywords: Coturnix japonica, Egg production, Egg quality, Probiotic

INTRODUCTION

With the increasing population and rising living standards, accompanied by a growing awareness of the importance of nutritional value in food for human needs and health, the demand for animal protein, particularly poultry eggs, continues to rise annually. Japanese quails (*Coturnix japonica*) are one of the avian species that have gained significant commercial popularity for producing of animal protein, particularly eggs, owing to their favorable characteristics. In West Sumatra, the quail population reached 1,492,424 individuals in 2022, reflecting a 1.1% increase since 2018 (Directorate General of Livestock and Animal Health, 2022).

Japanese quails are valued for their rapid growth, early sexual maturity, high annual egg production rate, reduced daily feed requirements, short egg incubation period, cost-effective feeding, and enhanced resistance to common poultry diseases (Rahman et al., 2016). Quail egg consumption ranks second in the world after chicken eggs, constituting approximately 10% of the global egg market (Lukanov, 2019). Quail eggs are rich in essential nutrients, serving as sources of protein, fat, vitamin E, minerals (iron, nitrogen, and zinc), and essential amino acids, primarily dominated by linoleic acid, docosahexaenoic acid, and arachidonic acid (Tunsaringkarn et al., 2013). Unfortunately, quail eggs are known for their high cholesterol content, leading some individuals, particularly adults, to avoid consumption. Quail eggs have the highest cholesterol content compared to duck and chicken eggs (Aziz et al., 2012).

Probiotic supplementation in feed is currently under extensive research and development, particularly to improve egg production performance and enhance the quality of quail eggs. The addition of *Lactobacillus fermentum* as a probiotic in feed has been shown to increase egg production and reduce cholesterol levels in Japanese quail eggs (Kalsum et al., 2012). Furthermore, the benefits of probiotics in feed have been observed in laying hens, leading to increased egg production, egg weight, and reduced cholesterol levels (Alaqil et al., 2020). *Pediococcus acidilactici* is a probiotic strain extensively employed in various applications to assess its potential benefits (Jazi et al., 2018; Yıldırım et al., 2020). *Pediococcus acidilactici* BK 01 is a well-established probiotic used in numerous fermented dairy products (Melia et al., 2021; Melia et al., 2022). However, using probiotics, particularly *Pediococcus acidilactici* BK01, in quails through drinking water, remains relatively unexplored. Therefore, this study aims to investigate the effects of adding *Pediococcus acidilactici* BK01 as a probiotic on the production performance, weight, fat content, and cholesterol levels of Japanese quail eggs.

MATERIALS AND METHODS

Materials, location, and ethical approval of study

This study utilized one-day-old female Japanese quails, with a total of 200 quails obtained from local farmers in the Lima Puluh Kota district, Indonesia. The quails were housed in cages, with a total of 20 units, each accommodating 10 quails, and these cages had dimensions of 120 x 50 x 23 cm. Commercial quail feed was employed for this study, procured from local stores in Padang, Indonesia. The probiotic *Pediococcus acidilactici* BK01 was obtained from the animal product technology laboratory of the Faculty of Animal Science at Universitas Andalas, which is an isolation of lactic acid bacteria from bekasam (Melia et al., 2019). All research procedures were conducted with the approval of the Health Research Ethics Committee of Universitas Andalas (No.154.laiketik/KEPKFKEPUNAND).

Experimental Design

The quails were provided with adlibitum feed and water as required daily until they reached ten weeks of age. The probiotic was administered via drinking water, with treatments of 0% (control), 1%, 2%, and 3%. Subsequently, when the quails had begun laying eggs, their production was recorded and the quality of the eggs was analyzed. The study encompassed the period from two weeks of age to ten weeks.

Production performance, fat, and cholesterol measurement

Production performance was evaluated in accordance with the method described by Alaqil et al. (2020). Quail Day Production was calculated by summing the eggs produced in each treatment group, divided by the number of quails alive each day, and multiplied by 100% (calculated as a percentage) during the experimental period. Egg weight was measured in grams (g) throughout the experimental period. The fat content was analyzed following the AOAC (2005) method using the Soxhlet method, and cholesterol content was determined using the cholesterol liquicolor kit, based on the Subekti et al. (2006) method.

Data Analysis

The research adopted an experimental approach utilizing a Randomized Block Design. Statistical analysis was performed using analysis of variance (ANOVA). Differences between treatments were analyzed using the Duncan Multiple Range Test (DMRT) at a 95% confidence level. The data were processed using SPSS 29.0 version (SPSS Inc., Chicago, Illinois, USA).

RESULTS AND DISCUSSION

Production Performance (Egg Production and Weight)

The administration of *Pediococcus acidilactici* BK01 probiotic via drinking water at various levels resulted in significant differences ($p<0.05$) in egg production (Table 1). The administration of probiotics at 2% and 3% levels yielded higher egg production (84.52% and 81.55%, respectively) than the control group (60.85%). However, the administration of 1% probiotics did not result in a significant difference ($p>0.05$) in egg production compared to the control group (71.42%). Regarding egg weight, the administration of *Pediococcus acidilactici* BK01 did not have a significant effect ($p<0.05$) in all treatment groups. Similar results were reported by Kalsum et al. (2012), where the use of *Lactobacillus fermentum* in Japanese quail led to increased egg production with rising probiotic concentrations, while it did not affect egg weight. In contrast, Lokapirnasari et al. (2018) reported a decrease in egg production and weight due using *Enterobacter Spp*., *Bacillus Spp*., *Cellulomonas Spp*., and *Actinomyces Spp*. compared to their control group.

Table 1. Quail egg production and weight

Treatment	Egg Production (%)	Egg Weight (g)
0%	60.85 ± 12.73^{a}	10.48±0.55
1%	71.43 ± 10.86^{ab}	10.50±0.16
2%	84.52 ± 3.71^{b}	10.66±0.01
3%	81.55 ± 11.89^{b}	10.91±0.48

Note: Different superscripts in the same column shows significant differences ($p<0.05$).

Generally, research results tend to report positive outcomes regarding probiotics, which can enhance egg production and weight (Hamada et al., 2023; Ilham et al., 2021; Zhang et al., 2012). This improvement can be attributed to probiotics' capacity to balance intestinal microbes by releasing active substances, enabling them to counteract specific pathogenic bacteria (Trela et al., 2020). Another mechanism involves the administration of probiotics, which can enhance nutrient absorption and digestion through increased metabolic processes, thus boosting egg production and weight (Zamanizadeh et al., 2021). However, differences that occur may also be influenced by various factors such as feeding methods, strains, and the age of the animals used (Koenen et al., 2004).

Fat and Cholesterol Contents

The fat and cholesterol levels in quail eggs supplemented with *Pediococcus acidilactici* BK01 are presented in Table 2. The results indicate that the administration of *Pediococcus acidilactici* BK01 probiotics at various concentrations significantly affects ($p<0.05$) the cholesterol level. Still, it does not significantly affect ($p>0.05$) the fat content of quail eggs. Cholesterol levels tend to decrease with increasing concentrations of probiotics. Similar findings were reported by Lokapirnasari et al. (2018), where the administration of *Enterobacter Spp., Bacillus Spp., Cellulomonas Spp., and Actinomyces Spp.* resulted in a significant reduction in cholesterol levels in quail eggs with increasing probiotic concentration. Increasing the concentration of *Pediococcus acidilactici* led to a more substantial reduction in cholesterol levels in egg yolks (Mikulski et al., 2012).

Table 2. The fat and cholesterol content of quail eggs

Treatment	Fat (%)	Cholesterol (mg/dL)
0%	20.08±0.76	215.43 ± 52.95^{a}
1%	20.20±0.58	161.10 ± 7.72^{ac}
2%	19.29±0.56	131.83 ± 13.85^{bc}
3%	18.84±0.52	98.57 ± 2.25^{b}

Note: different superscripts in the same column shows significant differences (p<0.05).

Probiotic administration has been reported to lower cholesterol levels in serum in both quails and broiler chickens (Jeni et al., 2021; Nour et al., 2021). This cholesterol reduction is associated with a decrease in serum cholesterol, where certain probiotic strains can hydrolyze bile acids through the enzyme BSH (bile salt hydrolase) produced in their metabolism, or inhibit the rate of hydroxymethyl-glutaryl-CoA enzyme in cholesterol formation (Pourakbari et al., 2016).

In this study, the fat content in quail eggs ranged from 18.84% to 20.08%. While not significantly different, the results indicate a decreasing trend in fat content with higher probiotic concentrations. Hamada et al. (2023) reported that various types of probiotics significantly reduced the fat content of quail eggs compared to the control.. However, the specific concentration of probiotics did not have a significant impact.

CONCLUSION

The use of *Pediococcus acidilactici* BK01 through drinking water positively impacts the production performance and egg quality of Japanese quails. The administration of 3% probiotics results in the highest egg productivity and the most significant reduction in cholesterol content. However, prebiotic concentrations up to 3% do not significantly effect the egg weight and fat content of Japanese quails' eggs.

CONFLICT OF INTEREST

All authors declare that there are no financial, personal, or other relationships with any other person or organizations related to the material covered in the manuscript.

REFERENCES

Alaqil, A. A., Abbas, A. O., El-Beltagi, H. S., Abd El-Atty, H. K., Mehaisen, G. M. K., & Moustafa, E. S. 2020. Dietary supplementation of probiotic *Lactobacillus acidophilus* modulates cholesterol levels, immune response, and productive performance of laying hens. Animals 10(9): 1–12. DOI: 10.3390/ani10091588.

Association of Official Analytical Chemists. 2005. Official Methods of Analysis. 18th ed. Association of Official Analytical Chemists, Gaithersburg, Mary Land, USA.

Aziz, Z., Cyriac, S., Beena, V., & Philomina, P. T. 2012. Comparison of cholesterol content in chicken, duck and quail eggs. J Vet Anim Sci 43: 64–66.

Directorate General of Livestock and Animal Health. 2022. Livestock and Animal Health Statistics *2022* (Vol. 1). Directorate General of Livestock and Animal Health. Jakarta. [Indonesian]

Hamada, O. M., El-Gendi, G. M., Eid, K. M., & Abdelmoez, W. 2023. The impact of multi-species bacteria as a probiotic on productive performance and egg quality of laying Japanese quail. South African Journal of Animal Science 53(4): 529–540. DOI: 10.4314/sajas.v53i4.07.

Ilham, E., Iwan, H., & Hery, S. 2021. Pengaruh penambahan probiotik Heryaki dalam ransum terhadap performa produksi dan kolesterol telur puyuh Padjadjaran. Jurnal Ilmu Ternak Universitas Padjadjaran 21(1): 73. DOI: 10.24198/jit.v21i1.33891.

Jazi, V., Foroozandeh, A. D., Dastar, B., Rezaie Koochaksaraie, R., & Toghyani, M. 2018. Effects of *Pediococcus acidilactici*, mannan-oligosaccharide, butyric acid and their combination on growth performance and intestinal health in young broiler chickens challenged with *Salmonella Typhimurium*. Poultry Science 97(6): 2034–2043. DOI: 10.3382/ps/pey035.

Jeni, R. El, Dittoe, D. K., Olson, E. G., Lourenco, J., Corcionivoschi, N., Ricke, S. C., & Callaway, T. R. 2021. Probiotics and potential applications for alternative poultry production systems. Poultry Science 100(7). DOI: 10.1016/j.psj.2021.101156.

Kalsum, U., Soetanto, H., Achmanu, & Sjofjan, O. 2012. Influence of a probiotic containing *lactobacillus fermentum* on the laying performance and egg quality of Japanese quails. International Journal of Poultry Science 11(4): 311–315. DOI: 10.3923/ijps.2012.311.315.

Koenen, M. E., Kramer, J., Van Der Hulst, R., Heres, L., Jeurissen, S. H. M., & Boersma, W. J. A. 2004. Immunomodulation by probiotic *lactobacilli* in layer- and meat-type chickens. British Poultry Science 45(3): 355–366. DOI: 10.1080/00071660410001730851.

Lokapirnasari, W. P., Dewi, A. R., Fathinah, A., Hidanah, S., Harijani, N., Soeharsono, Soepranianondo, K., Nurhajati, T., Sahidu, A. M., Karimah, B., & Andriani, A. D. 2018. Effect of Probiotic Containing *Enterobacter Spp., Bacillus Spp., Cellulomonas Spp., Actinomyces Spp.* Supplementation on the laying performance and egg cholesterol of quail. IOP Conference Series: Earth and Environmental Science 187(1). DOI: 10.1088/1755-1315/187/1/012030.

Lukanov, H. 2019. Domestic quail (*Coturnix japonica domestica*), is there such farm animal? World's Poultry Science Journal 75(4): 547–558. DOI: 10.1017/S0043933919000631.

Melia, S., Juliyarsi, I., & Kurnia, Y. F. 2022. Physicochemical properties, sensory characteristics, and antioxidant activity of the goat milk yogurt probiotic *Pediococcus acidilactici* BK01 on the addition of red ginger (*Zingiber officinale var. rubrum rhizoma*). Veterinary World 15(3): 757–764. DOI: 10.14202/vetworld.2022.757-764.

Melia, S., Juliyarsi, I., Kurnia, Y. F., Pratama, Y. E., & Azahra, H. 2021. Examination of titratable acidity, ph, total lactic acid bacteria and sensory properties in whey fermented with probiotic *Pediococcus acidilactic* BK01. Advances in Animal and Veterinary Sciences 10(1): 114–119. DOI: 10.17582/journal.aavs/2022/10.1.114.119.

Melia, S., Purwati, E., Kurnia, Y. F., & Pratama, D. R. 2019. Antimicrobial potential of *Pediococcus acidilactici* from Bekasam, fermentation of sepat rawa fish (*Tricopodus trichopterus*) from Banyuasin, South Sumatra, Indonesia. Biodiversitas 20(12): 3532–3538. DOI: 10.13057/biodiv/d201210.

Mikulski, D., Jankowski, J., Naczmanski, J., Mikulska, M., & Demey, V. 2012. Effects of dietary probiotic (*Pediococcus acidilactici*) supplementation on performance, nutrient digestibility, egg traits, egg yolk cholesterol, and fatty acid profile in laying hens. Poultry Science 91(10): 2691–2700.DOI: 10.3382/ps.2012-02370.

Nour, M. A., El-Hindawy, M. M., Qattan, S. Y. A., Abou-Kassem, D. E., Ashour, E. A., Aboelenin, S. M., Soliman, M. M., & Abdel-Moneim, A. M. E. 2021. Effect of graded levels of dietary *Bacillus toyonensis* and *Bifidobacterium bifidum* supplementation on growth, carcass traits and ileal histomorphometry and microbiota of growing quails. Saudi Journal of Biological Sciences 28(8): 4532–4541. DOI: 10.1016/j.sjbs.2021.04.054.

Pourakbari, M., Seidavi, A., Asadpour, L., & Martínez, A. 2016. Probiotic level effects on growth performance, carcass traits, blood parameters, cecal microbiota, and immune response of broilers. Anais Da Academia Brasileira de Ciencias 88(2): 1011–1021. DOI: 10.1590/0001-3765201620150071.

Rahman, A. N. M. A., Hoque, M. N., Talukder, A. K., & Das, Z. C. 2016. A survey of Japanese quail (*Coturnix coturnix japonica*) farming in selected areas of Bangladesh. Veterinary World 9(9): 940–947. DOI: 10.14202/vetworld.2016.940-947.

Subekti, S., Piliang, W. G., Manalu, W., Tri, D., & Murdiati, B. 2006. Penggunaan tepung daun katuk dan ekstrak daun katuk (*Sauropus androgynus l.merr*) sebagai substitusi

ransum yang dapat menghasilkan produk puyuh jepang rendah kolesterol. Jurnal Ilmu Ternak Dan Veteriner 11(4): 254–259. [Indonesian]

Trela, J., Kierończyk, B., Hautekiet, V., & Józefiak, D. 2020. Combination of *Bacillus licheniformis* and *Salinomycin*: Effect on the growth performance and git microbial populations of broiler chickens. Animals 10(5). DOI: 10.3390/ani10050889.

Tunsaringkarn, T., Tungjaroenchai, W., & Siriwong, W. 2013. Nutrient benefits of quail (*Coturnix coturnix japonica*) eggs. International Journal of Scientific and Research Publications 3(5).

Yıldırım, A., Kraimi, N., Constantin, P., Mercerand, F., & Leterrier, C. 2020. Effects of tryptophan and probiotic supplementation on growth and behavior in quail. Poultry Science 99(11): 5206–5213. DOI: 10.1016/j.psj.2020.07.047.

Zamanizadeh, A., Mirakzehi, M. T., Agah, M. J., Saleh, H., & Baranzehi, T. 2021. A comparison of two probiotics *Aspergillus oryzae* and *Saccharomyces cerevisiae* on productive performance, egg quality, small intestinal morphology, and gene expression in laying Japanese quail. Italian Journal of Animal Science 20(1): 232–242. DOI: 10.1080/1828051X.2021.1878944.

Zhang, J. L., Xie, Q. M., Ji, J., Yang, W. H., Wu, Y. B., Li, C., Ma, J. Y., & Bi, Y. Z. 2012. Different combinations of probiotics improve the production performance, egg quality, and immune response of layer hens. Poultry Science 91(11): 2755–2760. DOI: 10.3382/ps.2012-02339.