

Improving the quality of reproduction and quail production (*Coturnix coturnix japonica*) with liquid probiotics

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Abstract. This study aimed to determine the effect of various liquid probiotics in drinking water on the quality of quails' reproductive tract and production. The study used a Completely Randomized Design with four treatments, i.e., drinking water without liquid probiotics (P0), drinking water + commercial probiotics A (P1), drinking water + commercial probiotics B (P2), and drinking water + commercial probiotics C (P3). The treatment was repeated 5 times and each unit contained 5 quails. Drinking water was given ad libitum with liquid probiotic concentration of 2ml/litre. Quail feed contains 22.2% crude protein and 3032.5 kcal/kg metabolic energy. The observed variable were the weight and length of reproductive tract, egg weight, final body weight, slaughtered weight, dressed carcass weight, heart weight, gastrointestinal weight and length of caeca. Quail drinking water consumption was 2.48 - 2.74 times the consumption of feed. Analysis of variance showed that the liquid probiotic significantly affected the weight and length of the reproductive tract, egg weight, weight before and after slaughtered, weight after hair removal, heart weight, and gastrointestinal weight. There was no significant effect on carcass weight, liver weight, follicular weight, gizzard weight, digestive tract length and caeca length. In conclusion, liquid probiotics in drinking water produced different final body weight, digestive tracts and the size of reproduction tracts of quails than those in control group. The supplementation also increased the weight and length of quails' reproductive tracts. Compared to other probiotics, liquid probiotics A in drinking water produced the highest final weight, post-slaughter weight, dressed carcass weight, liver weight and digestive tracts weight.

Keywords: probiotics, quail, reproduction, production

Abstrak. Penelitian ini bertujuan untuk mengetahui pengaruh penggunaan berbagai probiotik berbentuk cair dalam air minum terhadap kualitas saluran reproduksi dan produksi puyuh. Penelitian menggunakan Rancangan Acak Lengkap pola searah dengan empat perlakuan yaitu: puyuh mendapat air minum tanpa probiotik cair (P₀), puyuh mendapat air minum dengan probiotik komersil A (P₁), puyuh mendapat air minum dengan probiotik komersil B (P₂), dan puyuh mendapat air minum dengan probiotik komersil C (P₃), ulangan 5 kali dan 5 ekor puyuh pada setiap unit penelitian. Air minum diberikan secara *ad libitum* dengan konsentrasi probiotik cair 2ml/liter. Pakan puyuh mengandung PK 22,2% dan energi 3032,5 kkal. Peubah yang diamati adalah bobot saluran reproduksi, bobot telur dan panjang saluran reproduksi, bobot potong, bobot setelah disembelih, bobot dress carcass, bobot jantung, berat saluran cerna, bobot karkas, bobot hati, bobot folikel, bobot gizzard, panjang saluran pencernaan dan panjang caeca. Konsumsi air minum puyuh 2.48 - 2.74 kalinya konsumsi pakan. Hasil analisis variansi menunjukkan bahwa penambahan probiotik cair ke dalam air minum berpengaruh sangat nyata terhadap bobot saluran reproduksi, bobot telur dan panjang saluran reproduksi, bobot potong, bobot setelah disembelih, bobot dress carcass, bobot jantung, berat saluran cerna, tetapi berpengaruh tidak nyata terhadap bobot karkas, bobot hati, bobot folikel, bobot gizzard, panjang saluran pencernaan dan panjang caeca. Kesimpulan dari penelitian ini bahwa penambahan probiotik cair ke dalam air minum berbeda dengan kontrol terhadap bobot akhir, saluran pencernaan dan saluran reproduksi puyuh. Penambahan probiotik cair ke dalam air minum puyuh meningkatkan bobot dan panjang saluran reproduksi. Penambahan probiotik cair A ke dalam air minum puyuh menghasilkan bobot akhir, bobot puyuh setelah dikeluarkan darahnya, bobot dressed carcass, bobot hati dan bobot saluran pencernaan paling tinggi dibandingkan probiotik yang lain.

Kata kunci: probiotik, puyuh, reproduksi, produksi

INTRODUCTION

Quail is a type of poultry that gains popularity as a producer of eggs and meat. Quail productivity was reflected from its

population in 2013 of 4,741,170 heads with a growth rate of 3.75% and egg production of 7,059,767 kg with 2.60% of which were hatched (Department of Animal Husbandry and Animal

Health of Central Java Province, 2014). Quail livestock development requires quality feed support for maximum productivity. Quality feed must contain nutrients for age development and breeding goals (Resnawati and Bintang, 2014). Supplementing probiotics into quality feed is considered safer for livestock products and beneficial for maintaining the health of the host, thus affecting reproductive performance and production. Probiotics are defined as single cultures or live microbial mixtures which, when applied in adequate doses, would benefit the host by maintaining healthy digestive tract (Antoine, 2010). Commercial probiotics are available in solid and liquid forms from various brands with different microbial compositions and sometimes supplements. This research aims to shed lights on improving the quality of digestive and reproduction tracts of quails

(*Coturnix coturnix japonica*) with commercial liquid probiotics through drinking water.

MATERIALS AND METHODS

Materials

The study was conducted at Ketapang Farm and the Laboratory of Nutrition Science and Animal Feed at the Faculty of Animal Husbandry, Universitas Jenderal Soedirman. The research was conducted from 1 September to 19 November 2018. The equipment included 20 experimental cages, cage curtains, scales (0.1g sensitivity), measuring devices (1mm sensitivity), measuring cups (0.1ml sensitivity), knives and trays. The research materials were one hundred 30-day-old female laying quails, commercial probiotics A, B and C (Table 1), and quail feed for production period with 22.20% Crude Protein (CP) and 3032.5 kcal GE (Table 2).

Table 1. Microbial composition and other components of liquid treatment probiotics

Probiotic	Microorganism	Other components
Probiotic A	<i>Lactobacillus sp</i> , <i>Rhodopseudomonas</i> , <i>Streptococcus</i> , <i>Saccharomyces</i> ,	Curcuma extract Nutrients (Protein, Ca, Mg, P and Vitamine C)
Probiotic B	<i>Acetobacter paspalii</i> , <i>Bacillus sp</i> , <i>Pseudomonas fluorescens</i> , <i>Sarcinalutea</i> , <i>Lactobacillus sp</i> , <i>Staphylococcus epidermis</i> , <i>Streptococcus thermophyllus</i> , <i>Saccharomyces cerevisiae</i> <i>Pichia anomala</i> .	Curcuma extract Mahkota Dewa extract
Probiotic C (EM4)	<i>Lactobacillus casei</i> 1,5 x 10 ⁶ cfu/ml <i>Saccharomyces cerevisiae</i> 1,5 x 10 ⁶ cfu/ml <i>Rhodopseudomonas palustris</i> 1,0 x 10 ⁶ cfu/ml	Molases 50 ml Water

Table 2. Chemical composition of quail ration

Feeds	Level(%)	CP(%)	GE(kkal)	Ca(%)	P (%)
Corn	42.5	3.8	1402.5	0.0085	0.1147
Rice bran	25.0	2.9	625.0	0.0350	0.1500
SBM	20.0	10.0	565.0	0.0540	0.1360
Ish meal	10.0	5.5	264.0	0.3800	0.2800
Top Mix	0.50	-	0.0	0.0269	0.0027
Corn oil	2.0	-	176.0	0.0	0.0
Sum	100.0	22.2	3032.5	0.5044	0.6880

Analysis by Laboratory of INMT Faculty of Animal Science, Universitas Jenderal Soedirman, Purwokerto

Method

The study used a Completely Randomized Design (CRD) with 4 treatments and 5 replications. The treatments were probiotics supplement in drinking water, namely P₀ = without probiotics, P₁ = probiotics A, P₂ = probiotics B, and P₃ = probiotics C. Each treatment unit consisted of 5 quails, and parameters that showed significant difference were subjected to HSD test. Quails were fed twice a day with 20g feed (per head/day) containing 22.2% CP and 3032.5 kcal energy. The variables observed were the weight and length of the reproductive tract, follicle weight, pre-slaughter weight post-slaughter weight, weight without feathers, carcass weight, heart weight, heart weight, gizzard weight, digestive tract weight, digestive tract length and caeca length.

RESULTS AND DISCUSSION

Drinking Water and Feed Consumption of Quails

The effect of liquid probiotics on quail drinking water consumption is presented in Table 3. Daily drinking water consumption for quails in this study was relatively similar to that of Sudrajat et al. (2015), Rinawidiastuti et al. (2019) and Widyastuti et al. (2014) namely 172.67 ± 14.14 ml -248.42 ± 63.08 ml per four quails, 59,69-68,23 ml/day/quail, and 44.31

ml/head/day quail, respectively. Despite the different types of probiotics in this study, quails average daily water intake was relatively similar (50.51 ml/head/day) which is approximately twice as much as the feed intake. Statistical tests showed that the effect of liquid probiotics was not significantly different ($P>0.05$) on drinking water consumption because the microbial effectiveness of each probiotic on quail feed consumption was relatively the same. Quails generally eat two to three times a day. Quail's feed consumption in this research (P₀) was 18.87 ± 1.92-20.02 ± 1.56 g/head/day, while the water intake was 2.48 to 2.74 times of feed consumption. Quail drinking water consumption in this study was slightly higher than 2 times in poultry at growth period (Risnajati, 2011) and 2 to 2.3 times (Altime et al. 2016), but lower than 3 times in a study by Marsudi (2012).

The analysis of variance showed that the addition of liquid probiotics had no significant effect ($P>0.05$) on feed consumption, partly due to the effectiveness of microbes in probiotics as well as the same dose of probiotics added to drinking water. As a result, the effect on intestinal physiology was also relatively similar. It was in accordance with Prawitya et al. (2014) that probiotics can perform their functions according to the microbial specifications if the environment is suitable; therefore, it maximizes the digestion and feed digestibility process.

Table 3. Drinking water and feed consumption of quails supplemented with liquid probiotics (ml/head/day)

Treatments	Average of drinking water consumption (ml/head/day)	Average of feed consumption (g/head/day)
P ₀	49.03±7.44	19.77±0.59
P ₁	51.83±7.23	18.87±1.92
P ₂	50.68±5.00	20.02±1.56
P ₃	48.66±4.44	19.52±0.89
Average	50.51±6.02	19.77±0.59

P₀= drinking water without probiotic, P₁= drinking water + probiotic A, P₂= drinking water + probiotic B dan P₃= drinking water + probiotic C

Reproductive Tracts of Quail

The effect of liquid probiotics on the quail reproductive tract is presented in Table 4. The research reported quail reproductive tracts weight (18.91-21.21g), follicular weights (3.98-4.59g) and quail reproductive tract length (21.70-25.38 mm). These results are similar to those of Hilkiyas et al. (2015), i.e. 6,127-6,674g, 3,238-4,166 g and 22,91-26,57mm, respectively.

Analysis of variance showed that liquid probiotics in drinking water had a significant effect ($P < 0.05$) on weight and length of reproductive tract because the probiotics increase the digestibility of nutrients, including protein. Protein in the body can increase oviduct development and follicular development (Hilkiyas et al., 2017). The use of probiotics C clearly resulted in the highest weight of reproductive tract. Probiotic bacteria work by sticking to the intestinal mucosa to form a layer that prevents pathogenic bacteria from developing, thereby increasing the work of the digestive tract and intestinal health as well as improving intestinal microflora (Mountzouris et al., 2010). The ideal digestive tract

environment made optimal absorption of nutrients by the small intestine villi. Hidayat et al., (2016) reported a marked increase in intestinal villi length, intestinal villi width and depth of intestinal crypts in male quails that orally supplemented with probiotics containing BAL 107-9 CFU / ml/head/day. Optimal nutrient absorption enables an adequate nutrient to support the growth and optimal performance of the reproductive tract as indicated by the weight of eggs and the length and weight of reproductive tract. Reproductive ability is related to the adequacy of feed energy status (Estrada-Cortés et al., 2009).

Productivity and Digestive Tracts of Quail

The effect of supplementation of liquid probiotics in quail drinking water on the quality of quail production is presented in Table 5. The final body weight of quail (quail pre-slaughter weight) in this study was relatively higher than the previous studies, i.e. $131.20 \pm 2.94 - 139.40 \pm 4.764$ g (Tugiyanti et al. 2018). However, the quality of other carcass characteristics were higher than those reported by Sarjana et al. (2010).

Table 4. Effect liquid probiotics on reproductive tracts of male quails

Treatments	Weight of the reproductive tract (g)	Follicular weight (g)	Length of reproductive tract (mm)
P ₀	18.91±1.70 ^a	3.98±1.93	21.90±2.08 ^a
P ₁	20.41±1.88 ^{bc}	4.59±1.04	23.91±1.45 ^b
P ₂	20.23±1.37 ^b	4.49±1.48	21.70±1.37 ^a
P ₃	21.21±1.64 ^c	4.49±0.08	25.38±0.56 ^c
Average	19.99±1.48	4.39±1.52	23.22±1.69

P₀= drinking water without probiotic, P₁= drinking water with probiotic A, P₂= drinking water with probiotic B dan P₃= drinking water with probiotic C, ^{abc} Different superscripts within column indicate significant difference ($P < 0.05$)

Table 5. Quality of quail production receiving liquid probiotics through water drink

Treatments	Final body weight (g)	Post-slaughter weight (g)	Weight of dress carcass (g)	Weight of carcass (g)
P ₀	159.12±3.12 ^b	152.27±3.44 ^b	141.78±4.90 ^b	88.30±4.86
P ₁	163.14±1.45 ^c	155.56±3.91 ^c	148.54±5.81 ^c	88.20±5.42
P ₂	148.66±1.86 ^a	143.80±3.86 ^a	138.58±6.92 ^a	88.98±6.27
P ₃	156.24±2.55 ^b	152.18±4.48 ^b	143.14±5.88 ^b	88.21±3.99
Average	156,79±2.76	150.95± 3.92	143.01±5.64	88.42±5.43

P₀= drinking water without probiotic, P₁= drinking water with probiotic A, P₂= drinking water with probiotic B dan P₃= drinking water with probiotic C, ^{abc} Different superscripts within column indicate a highly significant difference ($P < 0.01$)

Probiotics B resulted in the lowest quail final body weight, post-slaughter weight and dressed carcass weight. Analysis of variance showed that the supplementation of liquid probiotic had a highly significant effect ($P < 0.01$) on final body weight and quail post-slaughter weight, dress carcass weight and carcass weight. HSD test showed that the final body weight at P_2 is different from P_0, P_1, P_3 , also between P_1 and P_3 ; the post-slaughter weight at P_2 was different from P_0, P_1, P_3 and the dress carcass weight at P_1 was different from P_0, P_2, P_3 ($P < 0.05$). P_2 treatment on the three parameters of final body weight showed the lowest results across treatments although the microbes in P_2 were more varied than those in P_1 and P_3 . There was a suspected competition between microbes in utilizing feed nutrients which hindered the microbes' role in protecting the intestinal environment. Similar case was reported where the formation rate of acetic acid added with 15% (v/v) *Acetobacter xylinum* inoculum was lower than that of 10% v/v because the microorganisms were competing to use the existing nutrients or substrates (Aditiwati and Kusnadi, 2003).

The analysis of variance result showed that liquid probiotic supplementation in drinking water had no significant effect ($P > 0.05$) on the weight of the liver and gizzard as well as the length of digestive tracts and caeca. However, it showed a very significant effect ($P < 0.01$) on heart weight and a significant effect ($P < 0.05$) on

the weight of digestive tracts. The weight of heart and quail digestive tracts after being given probiotics increased because the probiotic supplementation increased digestion and metabolic processes. Body metabolism processes will increase the heart work to help circulate the oxygen through the blood. This is in accordance with Pittman and Rafael (2011) and Kubale et al. (2018) that the interplay of respiration, circulation, and metabolism is the key to the functioning of the respiratory system as a whole. The systemic circulation and pulmonary circulation are connected in series through the four chambers of the heart so that all blood pumped from the left ventricle into the systemic organs eventually makes its way back to the right ventricle from where it is pumped into the lungs. The main purpose of respiration is to provide oxygen to the cells at a rate adequate to satisfy their metabolic needs.

The heart weight of P_2 was the lowest because the variation of microbes in P_1 and P_3 the is less than that in P_2 . An optimal population can be achieved if a dose of probiotics is added to drinking water, i.e. 2ml/L drinking water. Probiotics can improve the digestive tract and increase the digestibility of feed by suppressing pathogenic bacteria in the digestive tract in order to support the development of beneficial bacteria that help the absorption of food substances (Kompiani, 2002).

Table 6. Weight and length of digestive organs and tracts of quail

Treatments	Weight of liver (g)	Weight of heart (g)**	Weight of gizzard (g)	Weight of digestive tract (g)*	Leght of digestive tract (mm)	Leght of Caeca (mm)
P_0	4.00±0.19	1.02±0.01 ^a	3.69±0.61	12.79±2.98 ^a	68.00±4.79	8.66±1.33
P_1	3.94±0.07	1.83±0.01 ^c	4.03±0.21	14.77±4.43 ^c	68.74±5.94	8.74±2.05
P_2	3.87±0.04	1.33±0.03 ^b	4.70±0.13	13.13±2.90 ^{ac}	70.02±6.93	9.40±0.89
P_3	4.26±0.14	1.75±0.02 ^c	4.21±0.07	13.96±2.65 ^{ac}	68.82±5.68	9.66±2.64
Average	4.02±0.08	1.48±0.01	4.00±0.42	13.66±3.48*	68.89±5.42	9.11±1.58

P_0 = drinking water without probiotic, P_1 = drinking water + probiotic A, P_2 = drinking water + probiotic B dan P_3 = drinking water + probiotic C., ^{abc} Different superscripts within column with sign ** indicate a highly significant difference ($P < 0.01$), ^{abc} Different superscripts within column with sign * indicate a highly significant difference ($P < 0.05$).

The surface area of the intestine to absorb nutrients is wider in chickens supplemented with probiotics *Bacillus* sp. than the non-supplemented (Sjofjan, 2003). Probiotics can change the movement of mucin and microbial populations in the small intestine of chickens in order to improve the intestinal function and health, the composition of microflora in the cecum, and the absorption of food substances (Mountsouris et al., 2010).

The weight of heart and digestive tracts of quail in probiotic treatment were heavier than those in control group. It showed that microbial activity in probiotics can provide a higher response to the weight of heart and the digestive tract than other variables. All probiotics contain lactic acid forming bacteria (*Lactobacillus*) and yeast (*Saccharomyces cerevisiae*). Lactic acid-forming bacteria such as *Lactobacillus* can produce acids that reduce pH, thus creating an atmosphere that could prevent pathogenic bacteria from developing (Hatmanti, 2000). Otherwise, the absorption of nutrients is optimal and the weight of heart ($P < 0.01$) and digestive tract ($P < 0.05$) are significantly higher. *Saccharomyces cerevisiae* can also oxidize pyruvate to D-lactic acid (Pronk et al., 1996). Carcass weight, liver weight, gizzard weight, digestive tract length and caeca length were not different with or without the liquid probiotic through drinking water.

CONCLUSION

Liquid probiotics supplementation in quails' drinking water resulted in different final body weight, parameters of digestive and reproduction tracts compared to control group. The supplementation also increased the weight and length of the reproductive tracts. Probiotics A produced the highest final weight, post-slaughter weight, dressed carcass weight, liver weight and digestive tracts weight compared to other probiotics.

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