Potency of probiotic on broiler growth performance and economics analysis

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ABSTRACT

The study was undertaken to know the economic analysis in broilers fed probiotic containing Lactobacillus casei and Lactobacillus rhamnosus supplementation in lieu of antibiotic growth promoters (AGP) to feed conversion ratio (FCR) and body weight (BW). The treatments were T0: control, T1: 0.01 g AGP/kg feed, T2: 0.05 g/ kg feed, T3: 0.1 g/kg feed, T4: 0.025 g probiotic/litre drinking water; T5: 0.05 g probiotic/liter drinking water. Data analysis was carried out using the Analysis of Variance (ANOVA) method, business analysis was held out by XLSTAT then analyzing descriptively. The results indicated that there was a significant difference among the treatments. Probiotic administration of T2, T3, T4 and T5 could increase broiler’s body weight and improve feed conversion ratio. The higher production performance and most profitable economic analysis was obtained with the addition of 0.025 g probiotic/litre (T4), which had the best results in a Break Even Point and Return Cost Ratio. It could be concluded that supplementation of 0.025 g probiotic/litre drinking water indicates the improve growth performance and profits in broiler.

Keywords: Antibiotic growth promoter, Body weight, Broiler chicken, Feed conversion ratio, Probiotics

Poultry is one of the fastest growing segments of agriculture and veterinary sector. Feed is one of the largest items of expenditure in poultry production and it alone accounts for 70% of total poultry production. The constant increase in the cost of poultry feed ingredients and compounded feed is making the profit less for poultry farmers. Therefore, balanced and effective feeding is most important requisite to superior germplasm for economic poultry production.

Several feed additives (such as growth promoter) like synthetic hormone and antibiotics have been extensively used for enhancing poultry production. However, application of AGPs in poultry can cause development of bacterial resistance to antibiotics and it can affect human health, due to the residues in chicken products. In European countries, the application of AGPs in poultry feed is prohibited. This situation has driven much research on the search for alternatives that are able to maintain high productivity and to be economically feasible, as well as not being harmful to human and animal health, thereby complying with the requirements of consumers and foreign markets. Among these alternatives, the use of probiotics in animal feeds stands out. Probiotics as feed additives prevent the gastrointestinal disorders based on competitive exclusion of potentially pathogenic bacteria, stimulate host immune response, and secrete antimicrobial substances (Corcionivoschi et al. 2010). These products do not leave residues in animal products and promote animal performance and health (Puller 1989, Jin 1997, Zulkifli et al. 2000, Ferreira et al. 2002, Patterson and Burkholder 2003), because they improve diet digestibility (Apata 2008), resulting in better nutrient utilization and consequently, higher productivity (Kabir et al. 2004, Mountzouris et al. 2007, Mountzouris et al. 2010). Probiotic giving to poultry can be given in the form of a mixture of feed or given through drinking water (Utomo 2012).

Lactic acid bacteria probiotics showed beneficial effect by inhibiting growth of pathogen bacteria, such as Escherichia coli (Huda et al. 2019, Najwan et al. 2019, Wardhani et al. 2019, Rahman et al. 2019) and Salmonella sp (Nouri et al. 2010). Lactic acid bacteria can survive by forming colonies of the intestine and can also produce lactic acid and bacteriocins (Salminen et al. 2004). Lactobacillus casei has both probiotic characteristics and antibacterial activity against different pathogens and can be used as potential functional probiotics in feed (Amaravadhi et al. 2012).

Probiotic treatment may be given through feed and water, expect that the consumption of probiotics through drinking water can increase body weight and decrease the value of feed conversion. Economic analysis can help estimate whether giving broiler probiotics in drinking water will be more profitable. The aim of this study was to know the broiler farm economics analysis, which uses probiotics
containing *Lactobacillus casei* and *Lactobacillus rhamnosus* to alternative antibiotic growth promoters (AGPs) to feed conversion and body weight.

**MATERIALS AND METHODS**

*Study area and farm management:* The research was conducted in the Faculty of Veterinary Medicine, Universitas Airlangga, Surabaya, Indonesia. Broiler *day old chick* (DOC; 240) were randomized into six treatments (*T*0, *T*1, *T*2, *T*3, *T*4 and *T*5), each treatment consisted of forty replications and each replication consisted of 10 heads, as follows: *T*0: Control, 100% standard feed; *T*1: standard feed + 0.01 g AGP/kg of feed; *T*2: standard feed + 0.05 g/kg of feed; *T*3: standard feed + 0.1 g/kg of feed; *T*4: standard feed + 0.025 g probiotic/litre in drinking water and *T*5: standard feed + 0.05 g probiotic/litre in drinking water.

Standard feed is a feed composed of protein feedstuff and energy sources that are formulated according to the needs of the broiler chick. In the standard feed, antibiotics were not added, but the nutrient value in feed is suitable to fulfill nutrient requirement of broiler chick. A total of 0.01 g of AGP was mixed in 1,000 g feed (*T*1); 0.05 g of probiotic (*T*2) (concentration 1.2×10^6 CFU/gram), dissolved in 1,000 mL of water (free of chlorine and other antiseptics), 0.1 g of probiotic (*T*3) dissolved in 1,000 mL of water, and then allowed to stand for 24 h without aeration. A total of 1,000 mL of probiotic solution was sprayed evenly on 1,000 g of feed and then the feed was left to dry, so that the probiotics are absorbed well in the feed, then the feed is ready to be given. 0.025 g of probiotic (*T*4) dissolved in 1,000 mL of water (free of chlorine and other antiseptics), 0.05 of probiotic (*T*5) dissolved in 1,000 mL of water, then allowed to stand for 24 h without aeration. A total of probiotic solution is mixed in 1000 mL of water, then stir evenly and drinking water ready to be given. The broiler chick was fed twice daily at 7 AM and 5 PM. The feed was given *ad lib.* in mash form. Water was also provided *ad lib.*

*Data collection:* Data related to the sum total of the poultry feeding and weight were collected every week. The body weight was obtained by weighing the chickens every week using digital scales. The feed consumption was calculated by subtracting the leftover feeds from the sum total of the given diets per week. The results of the calculation were then employed to determine the Feed Conversion Ratio (FCR). The calculation of the feed conversion using the following formula: Feed Conversion ratio = Feed Intake (g)/average of weight gain (g). The feed price was calculated based on the total amount of consumption multiplied by the price of feed per kilogram. The revenue was calculated from the total weight produced multiplied by the selling price of the chicken weight per kilogram.

*Statistical analysis:* Data analysis was performed using analysis of variance (ANOVA). If the result is significantly different then continued with Duncan’s multiple range test. Statistical analysis using SPSS for Windows 21.0.

### RESULTS AND DISCUSSION

**Feed conversion ratio:** Addition of probiotics through feed and water, affect the feed conversion ratio (*P*<0.05). Furthermore, *T*3 showed the significantly highest difference compared to control. The treatment *T*1 was significantly different to *T*0, *T*2, *T*3, *T*4 and *T*5. The treatment *T*2 was not significantly different from *T*3 but significantly different from *T*1, *T*4 and *T*5, while *T*3 was significantly different with *T*1 and *T*4. The result of the feed conversion in Table 1.

**Table 1. Feed conversion ratio and body weight of broiler chicken in treatment**

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Feed conversion ratio±SD</th>
<th>Body weight (g)±SD</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>T</em>0</td>
<td>2.09±0.01</td>
<td>1,697±49.7</td>
</tr>
<tr>
<td><em>T</em>1</td>
<td>1.75±0.01</td>
<td>1,923±19.0</td>
</tr>
<tr>
<td><em>T</em>2</td>
<td>1.65±2.4</td>
<td>2,003±8.60</td>
</tr>
<tr>
<td><em>T</em>3</td>
<td>1.64±2.8</td>
<td>2,021±4.87</td>
</tr>
<tr>
<td><em>T</em>4</td>
<td>1.62±0.01</td>
<td>2,025±12.1</td>
</tr>
<tr>
<td><em>T</em>5</td>
<td>1.63±0.01</td>
<td>2,010±12.4</td>
</tr>
</tbody>
</table>

SD, Standard deviation; a,b,c,d,e,f Means having different superscripts within the same column different significantly (*P*<0.05).

*T*0 was significantly different from *T*1, *T*2, *T*3, *T*4 and *T*5. This shows that the addition of feed additives through broiler feed and water can reduce the feed conversion ratio. As explained by Wiryawan *et al.* (2007), feed conversion is needed to describe the extent to which the biological effectiveness of nutrient used in feed, the smaller the amount of feed needed to produce additional chicken weight, means the more efficient the feed is.

The treatment of *T*2 was not significantly different from *T*3, but significantly different from *T*1, *T*4 and *T*5 treatment. Adding probiotics to feeds can maintain microflora balance in the digestive tract and inhibit pathogenic bacteria, increase digestive enzyme activity, decrease ammonia production, improve feed intake and digestion, neutralize enterotoxins and stimulate the immune system (Manin *et al.* 2010, Yulianto and Lokapirnasari 2018). These results are also consistent with the results reported by other researches (Sathy and Muragian 2015, Lokapirnasari *et al.* 2017) that probiotics can improve feed intake and decrease the feed conversion significantly.

The treatment *T*3 was not significantly different from *T*5, but significantly different from *T*1 and *T*4. The probiotics can enhance microbial activity and digestibility in the broiler digestive tract, with the increasing number of population.
of microbes in the digestive tract, the absorption of feed substances becomes larger and more effective, which affect feed efficiency (Suroso et al. 2016). The results agree with the findings of Yeo and Kim (1997) and Anjum et al. (2005) who reported that the use of probiotic in broiler chicks diet significantly improved the daily body weight gain and feed efficiency. This may be attributed to the increase in microbial resistance to antibiotics and residues in chicken (Perreten 2003). The Lactobacillus sp was able to colonize the intestinal tract and feed, and remain at a high concentration of 10^7 to 10^9 CFU/g, respectively.

The treatment T4 had the highest significant influence on the conversion, which may be due to many factors. Water consumption of animals also depends on other factors such as activity, environmental temperature, and dryness of the feed, which require much water and relative humidity (Aduku, Lokapirnasari et al. 2017). Nutritional status, duration of starvation and the relationship between water consumption and animal feed could be used as one of the factors that may affect the responses of animals to be considered (Cabrera and Saadoun 2006, Lokapirnasari et al. 2017). It is important that farms are equipped to provide adequate water volume for optimal development. The fact that water consumption has increased significantly over the past 10 and 20 years is evidence that farm waters systems may need to be evaluated to ensure drinking systems are keeping up with the changing water needs (Williams et al. 20013, Lokapirnasari et al. 2017). This result contrasts (Pambuka et al. 2014, Lokapirnasari et al. 2017) that the rise in feed and water consumption is recorded in laying hens fed with probiotics mixed liquid culture containing two types of microorganisms, Lactobacillus and Bacillus species.

The balance of microflora population in the gut is expected to lead to a greater efficiency in digestibility and utilization of feed, which consequently, results in an enhanced growth and improved FCR (Bedford 2000, Choudhari et al. 2008). The significant benefits of antibiotic supplementation observed on chick growth and feed conversion in this study, were in agreement with many reviewers (Mehdi 2011). Probiotics could suppress the growth of pathogenic microorganisms in the intestine and the incidence of diarrhea, on the other hand has the potential to increase the bioavailability of dietary minerals resulting in an improved growth rate and feed efficiency (Lokapirnasari et al. 2019). Lactobacillus administration has been shown to improve growth rates and feed conversion ratio in broiler chickens (Kalavaththy et al. 2003).

**Body weight:** Addition of probiotics through feed and water, affect the body weight (P<0.05). Furthermore, treatments T2, T3, T4 and T5 were not significantly different, but significantly different to AGP (P1), and T4 showed had the highest body weight. The result of the body weight are given in Table 1.

T0 was significantly different from T1, T2, T3, T4 and T5. Based on probiotic studies used using probiotics Lactobacillus sp., probiotic Lactobacillus sp can metabolize carbohydrates into lactic acid, which causes the atmosphere
of the pen and land lease fee of each treatment for all inputs which used in this analysis is real. Input price is the price which prevailing at the time of the study.

**Fixed cost:** Fixed costs are costs that are not influenced by the size of total product, and it is equal in every year. The fixed costs consist of pen and equipment depreciation. Pen and equipment depreciation costs are calculated with depreciation formula that divided the economic life of the investment costs, which the equipment has an economic life of 2 years. There are no electricity costs because it is already included in the land lease fee and there are no labour costs because everything is done by the researcher. Fixed costs have the same amount of treatments because the equipment used is the same. Fixed costs are given in Table 2.

**Variable cost:** Cost of production consists of fixed costs and variable costs (Alfikri et al. 2013). Project time is based on a long research, which is 4 weeks, so that the variable costs are calculated on the cost of production for 5 weeks. Variable costs are costs which amount is influenced by the amount of product. Variable costs consist of the cost of transport, bran, feed, feed additives, DOC broiler and feed. The difference showed in variable cost, on the feed and feed additive costs.

In poultry production, total expenses greatly influenced by the price of feed that can reach up to 70% of the total cost (Abdurrofi et al. 2016). The cost of feed is calculated from the total of feed intake of each treatment for five weeks multiplied by the price of feed is the Indonesian rupiah (IDR) 4,543 per kilogram feed. The precise information on feed conversion is important to calculate each bird feed consumption (Sahzadi et al. 2006). The results showed that the lowest feed costs was IDR 1,219,765 (T 2).

Cost of feed additives is the amount of feed additive given for 5 weeks multiplied by the price of feed additive, which is IDR 40,000 per 500 g of AGPs (T 1) and IDR 25,000 per 100 g of probiotic (T 2, T 3, T 4, and T 5). The T 0 is not given a feed additive, so that the cost of feed additive is IDR 0. The highest cost of feed additive was with T 5 which uses 0.05 probiotic/liter in drinking water (IDR 9,857,5) and the lowest feed additive cost was in the P1 which used AGPs, IDR (226,96).

The results showed that the lowest variable cost or the most efficient was with T 4 (IDR 2,024,667) while the highest variable cost was with T 1 (IDR 3,269,668).
highest variable costs in P0 (IDR 2,110,168) due to the high cost of feed additives. The variable cost is given in Table 3.

**Revenues and profits:** The flow of revenues is from the sale of total final weight. Revenues are obtained based on broiler final weight (kg) multiplied by the selling price of broiler IDR 24,000/kg final body weight.

The results showed that the highest total income in the T(4) (Standard feed + 0.025 probiotic/liter in drinking water) IDR 4,920,000 and affects the profits, where T4 get the highest benefit IDR 1,735,823, which is due to higher production of final body weight in T(4). Profit condition happens if the income is greater than the cost of production (Soepranianondo et al. 2013). Total revenues and profits can be seen in Table 4.

**Economic analysis:** Results indicate that best BEP production and BEP price is T(4) only with the production of 0.65 kg final body weight at a price of IDR 15,532/kg which does not give a profit or a loss. BEP value can indicate the level of production and the price of what a business does not provide a profit nor a loss (Soepranianondo et al. 2013). The economics analysis is shown in Table 5.

Based on the results, the best R/C ratio was shown in T(4) treatment (1.55). The criteria for the calculation of business efficiency, namely, when the R/C ratio <1, then the business is said to be inefficient, when the R/C ratio is equal to one, the business is said to be unprofitable or no damage and if the R/C ratio is more than one then said to be efficient or beneficial (Soepranianondo et al. 2013). Hence, the business is worth it because it has a value of more than 1. Net R/C 1.34 means that every IDR 1, the costs over the life of the project resulted in IDR 1.34 revenue.

Probiotics administration of T2, T3, T4 and T5 through feed, and drinking water can increase body weight and reduce feed conversion. The higher production performance results and most profitable economic analysis are the addition of 0.25 g probiotic/liter in drinking water. So the farmers can give 0.025 g probiotic/liter through the water to get the best production performance and profit.

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