Nutrient digestibility and meat production of broiler chicken fed with symbiotic (a mixture of *Lactobacillus casei* and garlic powder)

I Mangisah1,2*, V D Yunianto1, S Sumarsih1 and S Sugiharto1

1Department of Animal Science, Faculty of Animal and Agricultural Sciences, Diponegoro University, Semarang 50275, Central Java, Indonesia
2Vocational School, Diponegoro University, Semarang, Central Java, Indonesia

*E-mail: istnamangisah@yahoo.co.id

**Abstract.** This research aimed to investigate the effect of a symbiotic of *Lactobacillus casei* and garlic powder (SLG) as an antibiotic substitution on nutrient digestibility and meat production of broiler chickens. A total of 175 of 1-day-old chick were allotted to 5 dietary treatments, i.e. antibiotic, symbiotic 0, 1, 2 and 3%. The study was arranged with a completely randomized design. The observed variables included nutrient digestibility (protein, crude fiber, fat) and meat production. Dietary symbiotic supplementation significantly increased nutrient digestibility and meat production in broiler chickens. SLG treatment significantly affected and better than control. Protein digestibility in the antibiotic group was better than in the control group, but the same as in the symbiotic group. Meanwhile, the digestibility of crude fiber and crude fat in the antibiotic group was lower than the symbiotic group. This means that symbiotic can be used as a substitute for antibiotics. In conclusions, broilers in the SLG treatment group showed better nutrient digestibility and meat production than control. Symbiotic of *Lactobacillus casei* and garlic powder (SLG) can be effectively used to growth promoter in the broiler chickens.

1. **Introduction**

The intestinal microbiota plays an important role in metabolic processes, nutrient absorption, growth performance and host health. The use of antibiotics and other drugs to increase the productivity of broiler chickens has not only altered the gut ecosystem and microbial balance but also led to its emergence pathogenic bacteria resistant to antimicrobials, which endanger livestock and consumer health. Therefore, the use of antibiotic growth promoter has banned and currently it is necessary to explore natural materials, which function as growth spurs, increase immunity, livestock production and are safe for consumers.

Some natural additives for poultry include probiotics, prebiotics, and a combination of the two as symbiotic. Probiotics are single or mixed cultures of living commensal microorganism, when administered can provid a health benefit on consumers/host [1]. Probiotics have various mechanisms
of action, including competitive exclusion, stimulating villi and intestinal integrity, improving the immune system, preventing inflammation, increasing the process of nutrient metabolism, and improving growth performance [2]. Singh et al., [3] reported that the administration of probiotics together with multi-enzymes in fibrous rations led to an increase in metabolic energy and protein digestibility in broiler chickens. Lactobacillus requires several substrates to support its growth. One of the ingredients as a food substrate is garlic.

Garlic (Allium sativum) contains 1-2% fructooligosaccharides (FOS) [4] and contains quite high inulin (18.62%). Garlic also contains various bioactive components including phenolic compounds (70.24 mg/g), organosulfur and saponin, which can improve the health of the digestive tract [5]. Broiler feed supplemented with garlic flour can improve the digestive system, thereby optimizing nutrient digestion and absorption, ultimately enhance the growth performance [6].

The use of symbiotic has a better effect than supplementation of probiotics and prebiotics separately, because specific substrates are available for fermentation. Several studies have stated that symbiotic supplementation in feed can improve the growth performance of chickens [7], [8]. The use of symbiotic (mixture of L. casei and garlic) is expected reducing undesired effects of antibiotics, improving the animal health status and contributing to the increase of food safety.

2. Material and method
2.1 Symbiotic preparation

The pure isolate of L. casei was obtained from the Laboratory of Microbiology, Gadjah Mada University. Bacterial cultures were made, with the target population of L. casei (10⁹ cfu / mL) at the Central Laboratory of Diponegoro University. The preparation of symbiotic (L. casei and garlic powder) was done by taking 1 ose of L. casei (10⁹ cfu / g), then was inoculated it in 50 ml of 10% skim milk solution. Furthermore, it was incubated at 37°C for 2 days. The results of the incubation were then added with sterile garlic powder as much as 1.5% (w / v) and were incubated again for 2 days. The incubation result is called symbiotic from L. casei and garlic powder (LSG). The bacterial population in SLG was calculated by the total plate count (TPC) method [9]. SLG were used as feed additives in broiler maintenance in this study.

2.2 Animal and feed

One hundred and seventy-five-day old chick, with an average weight of 43.70 ± 0.88 g were used as experimental material. The experiments were arranged in a completely randomized design. Broiler chickens were grouped into 25 pens. Each pen was occupied by 7 chickens. The treatments were antibiotic, control, and the addition of symbiotic to the ration (SLG1 = ration + symbiotic 1ml/g; SLG2 = ration + symbiotic 2ml/g; SLG3 = ration + symbiotic 3ml/g; (fresh ingredients). The ration used contains metabolic energy of 3000 kcal / kg and 21% crude protein.

2.3 Parameters measured

The nutrient digestibility test was carried out by total collection method on day 21 to day 24. The collected excreta was then dried and analyzed for crude protein, crude fiber and crude fat. During excreta collection, feed consumption was recorded. The final body weight, carcass and meat weight were determined at the end of the finisher period (35 days). Crude digestibility of protein, crude fiber and crude fat was measured according to [10], and [11], as follows:

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\text{Nutrient digestibility} = \left(\frac{\text{nutrient consumed} - \text{nutrient in excreta}}{\text{nutrient consumed}}\right) \times 100\% \quad (1)
\]

2.4. Statistical analysis

The collected data were analyzed using analysis of variance and if the treatment showed a significant effect, it was followed by Duncan's multiple range test.
3. Result and discussion
Dietary symbiotic supplementation of both *L. casei* and garlic flour (SLG) significantly increased nutrient digestibility in broiler chickens (Table 1). The increase in nutrient digestibility was thought to be the effect of the increasing population of commensal bacteria (lactic acid bacteria/LAB) in the digestive tract. A high population of LAB could ferment the prebiotic substrate to produce lactic acid and short chain fatty acids (SCFA), so that the pH of the digestive tract decreased, the population of pathogenic bacteria decreased and the digestive tract becomes healthier. Intestinal microbial conditions greatly affected intestinal health and the process of digestion of nutrients. The results of this study are in accordance with [12] who stated that probiotics such as *Lactobacillus* sp. culture reduces the availability of nutrients or food for pathogenic bacteria and increases colonization of lactic acid bacteria. This increase in non-pathogenic bacteria (LAB) in the intestine is also known to produce harmful metabolites, such as antimicrobials (bacitracin), carbon dioxide (CO2) and hydrogen peroxide. This metabolite is a dangerous metabolite which interferes with the growth of pathogenic bacteria and increases the growth of beneficial bacteria in the small intestine [13]. The results of this study are supported by Mangisah et. al. [14], that symbiotics 2% from *L. casei* and dahlia tuber extract as well as *L. casei* and garlic extract improved intestinal microbes, increased digestion process and nutrient digestibilities.

Protein digestibility in the antibiotic group was better than in the control group, but the same as in the symbiotic group. Meanwhile, the digestibility of crude fiber and crude fat in the antibiotic group was lower than the symbiotic group. This means that symbiotic can be used as a substitute for antibiotics.

**Table 1.** Nutrient digestibility of broiler chickens.

| Digestibility     | Treatments | SEM | p-value |
|-------------------|------------|-----|---------|
|                   | antibiotic | control | SLG1 | SLG2 | SLG3 |       |         |
| Crude Protein     | 82.22b     | 79.67c | 85.79a | 83.58a | 81.93b | 0.59 | 0.003 |
| Crude fiber       | 20.97c     | 22.33b | 24.41a | 25.75a | 26.73a | 0.601 | 0.015 |
| Crude fat         | 81.28b     | 81.13b | 85.07a | 86.20a | 87.18a | 0.738 | 0.036 |

The inclusion of symbiotic SLG (*L. casei* and garlic powder) had a significant effect on increasing growth, carcass weight and meat weight of broilers (Table 2). The symbiotic treatment (SLG1, SLG2, and SLG3) gave better results compared to the control group. SLG1 showed the best results on data on body weight, carcass weight and meat weight, compared to the antibiotic group and the control group. The addition of SLG symbiotic to broiler chicken rations had effect on reducing gastrointestinal pH, reducing pathogenic bacteria and increasing the LAB population. The intestinal conditions with a good balance of bacteria lead to better digestion and absorption. The greater the absorption of nutrients, the availability of nutrients for the formation of meat tissue will increase, this can be seen from the carcass weight and meat weight data in Table 2. The results of this study are supported by Cheng et. Al. [15-17], that the symbiotic supplementation of food into the ration can improve the growth performance and carcass composition, resulting in good quality of meat.

**Table 2.** Meat production of broiler chickens.

| Items            | Treatments | SEM | p-value |
|------------------|------------|-----|---------|
|                  | Antibiotic | Control | SLG1 | SLG2 | SLG3 |       |         |
| Final body weight (g) | 1910.02b | 1896.15c | 2016.67a | 2000.01a | 1943.67b | 9.82 | 0.15 |
| Carcass weight (g)   | 1254.09b | 1223.12c | 1279.03a | 1263.67b | 1266.33b | 4.006 | 0.001 |
| Meat weight         | 779.35b  | 770.35c | 841.33a | 829.71b | 834.66b | 6.537 | 0.035 |
4. Conclusions
The conclusion of this study showed supplementation SLG (a mixture of L. casei and garlic powder) could improve nutrient digestibility and meat production of broiler chicken. The best treatment was the SLG1 treatment, which resulted in an increase in body weight with the highest meat weight.

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Acknowledgment
The financial support provided by Institute for Research and Community Service, Diponegoro University through the "Program Riset Pengembangan dan Penerapan (RPP)" due to the valuable funding contribution with the contract number 233-93/UN7.6.1/PP/2020.