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Original Article

Potential of Liquid Probiotics Bacillus subtilis and Bacillus coagulans on Broiler Chicken Carcas Percentage and Business Analysis

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ABSTRACT

The aim of this research was to find out liquid probiotic *Bacillus subtilis* and *Bacillus coagulans* as feed additives to carcass percentage and economic analysis in the broiler. This research used 24 broiler aged 20 day. P0 (control group) was given 2 ml of aquadest. P1, P2, and P3 were given liquid probiotic Bacillus subtilis and Bacillus coagulans with different dosages, respectively (2 ml, 4 ml, and 6 ml). The sample of data was taken by weighing broiler manually. The data of carcass percentage was analyzed using one-way Analysis of Variance (ANOVA), and if it showed a significant difference, continued by the Duncan test as a post-hoc test. The data of business analysis was analyzed by descriptive. The result of this research indicated that all doses of 2 ml, 4 ml, and 6 ml of liquid probiotics had significant differences ($p<0.05$) in carcass percentage. The result of doses 4 ml of liquid probiotic was most higher than doses 2 ml and 6 ml in carcass percentage. Business analysis in this research gave effect in contribution margin and value > 1 of the revenue cost ratio which could be stated that the broiler business was feasible.

Keywords: Broiler, *Bacillus subtilis*, *Bacillus coagulans*, carcass percentage, business analysis

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Introduction

The nutritional need for protein from animal sources increases every year so that broiler chicken farming has promising business prospects because one source of animal protein that is easy to obtain is broiler chicken meat. Apart from that, the growth or meat production process for broiler chickens is relatively short, in just 4-5 weeks broiler chickens can be harvested and consumed (Sahraei, 2012). Broiler chickens are one of the main sources of meat in many countries. The demand for meat from chickens, especially from fast food restaurant chains, causes many farms and ranches to keep broiler chickens because broiler chickens can grow quickly (Castro *et al.*, 2023). The need for rapid growth of broiler chickens with the addition of feed additives can also have an effect on livestock business activities.

Antibiotic Growth Promoters (AGP) as a feed additive which is usually given in feed can improve the performance of intestinal filtration, so that food absorption in the intestine increases (Lin, 2014), and ultimately is thought to have an effect on increasing body weight growth, feed conversion, fat, and carcass percentage as well as other chicken body organs. However, because of its semi-synthetic nature, it can give rise to new problems, namely antibiotic residues in meat as a side effect of continuously administering antibiotics in feed.

Antibiotic residues are toxic to consumers; in addition, antibiotics can create resistant microorganisms in the human body or livestock, especially pathogenic bacteria such as Salmonella, Escherichia coli, and Clostridium perfringens (Economou and Gousia, 2012). There needs to be an alternative to antibiotics, namely the use of probiotics in feed. Probiotics are microorganisms that can live or develop in the intestine and can benefit their hosts (Kechagia *et al.*, 2013).

Probiotics are additional feed in the form of live, non-pathogenic microorganisms whose working mechanism is to maintain balance in the digestive tract by influencing the intestinal microflora and eliminating host pathogenic microorganisms. One of the roles of probiotics is to produce an acidic atmosphere, thereby creating an uncomfortable environment for the growth of pathogenic bacteria (Latif *et al.*, 2023). It is hoped that the provision of probiotics will benefit the broiler chicken farming business by improving the quality of healthy carcasses and as a substitute for antibiotics. The parameter that can be measured is by looking at the carcass percentage.

The production objective in broiler farming is the carcass, while the fat in the carcass is a byproduct and is waste from a chicken slaughterhouse. According to Hafid (2021), the carcass is a chicken that has been cut clean without a head, claws, and innards (liver, heart, kidneys, gizzard, intestines). Carcass weight is a reflection of the meat production of an animal and measuring carcass weight is an important factor in evaluating livestock production results. As the weight of the carcass incrzeases, the farmer's profits will increase.

The sustainability of a broiler farming business is largely determined by the breeder's knowledge of aspects of business feasibility. A business is said to be feasible if it meets requirements such as market and marketing feasibility, technical feasibility, and financial feasibility (Wibowo *et al.*, 2021). Production and business management aspects are expected to increase contribution margins (Farida and Setiawan, 2022).

This study aims to determine the response to giving liquid probiotics Bacillus subtilis and Bacillus coagulans to broiler chickens and analyze the broiler business by examining the contribution margin and R/C values. It is hoped that the results of the research will provide information for farmers as evaluation material in their broiler cultivation business and for future decision-making.

Materials and methods

Research design

This research was carried out in October-December 2021. The adaptation period, induction and therapy provided to Lohmann strain broiler experimental animals were carried out in the Experimental Animal Cage, Airlangga Faculty of Veterinary Medicine. The experimental animals used were 24 Lohmann strain broiler chickens aged 21 days, divided randomly into battery cages, given a controlled feed of 160 grams/head/day, and drinking water ad libitum. The sample size was calculated using the Federer formula (Charan and Kantharia, 2013). This research is an experimental study using a Completely Randomized Design (CRD) research design consisting of four treatment groups and six repetitions, with the following treatments:

P0 = Giving distilled water 2 ml/chicken/day orally (control)

P1 = Oral administration of bacterial isolate 2 ml/chicken/day

P2 = Oral administration of bacterial isolate 4 ml/chicken/day

P3 = Oral administration of bacterial isolate 6 ml/chicken/day

Cage preparation stage

Six plastic lateral battery cages measuring 120 cm x 56 cm x 35 cm with a capacity of 4 animals. The cage is installed at a height of 50 cm from the floor. Before use, the cage and room are thoroughly sprayed with disinfectant. Broiler chickens were included randomly after the initial body weight of the chickens was weighed using a lottery method.

Feeding phase

Chickens are given food twice a day and the amount of feed is adjusted based on age with commercial feed. Drinking water was provided ad libitum.

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Treatment phase

A total of 24 chickens were divided into four treatment groups with six replications. Liquid probiotic treatment is given directly orally by disonde and is carried out from the age of 21 days to 35 days at 14.30 UTC+8.

Harvest phase

Chickens are fasted for 12 hours before harvesting. On the 36th day, data was collected on the body weight of live chickens before slaughter; then data was collected on chicken carcass weight.

Data analysis

The research results were analyzed using One Way Analysis of Variance (ANOVA) using the SPSS for Windows 26.0 application to see the real differences between each treatment group. If there is a real effect, Duncan's multiple range test is continued with a significance level of 0.05. Business analysis data, including Contribution Margin and Revenue Cost Ratio, are analyzed descriptively.

Result

Carcass percentage

The carcass percentage was obtained by taking data on live weight and broiler carcass weight. This data was taken during the last research period. The results of statistical tests on administering liquid probiotics Bacillus subtilis and Bacillus coagulans showed a significant difference ($p<0.05$) in the percentage of broiler chicken carcasses. The results of the analysis of carcass percentages in broiler chickens given liquid probiotics are presented in Table 1.

Table 1. Mean and standard deviation (SD) of carcass percentage

Group	Mean ± SD Carcass Percentage (%)
P0	$62.59^{a} \pm 7.24$
P1	$68.22^{b} \pm 2.98$
P2	$76.77^{c} \pm 1.81$
P3	$69.15^{b} \pm 4.22$

Note: Different superscripts in the same column indicate a significant difference between treatments ($p<0.05$) (P0 = control; P1 = 2 ml probiotic; P2 = 4 ml probiotic; P3 = 6 ml probiotic

Business analysis

The business analysis component in this research is obtained by calculating the Contribution Margin (CM) and business feasibility or Revenue Cost Ratio (R/C). Contribution Margin (CM)

Table 2. Contribution Margin (CM) of broiler chickens for each treatment

Group	TR (Rp)	VC (Rp)	CM (Rp)
P0	196,024.1	119.616	76,408.1
P1	237,396.2	128.016	109,380.2
P2	287,942.8	136.416	151,526.8
P3	234,280.3	144.816	89,464.1

Note: TR = Total Revenue, VC = Variabel Cost, CM = Contribution Margin, Rp = Rupiah

Contribution margin is the difference between total revenue and variable costs (Gutiérrez *et al.*, 2021). The urgency of calculating the contribution margin is to know the amount of profit obtained from covering fixed costs (Mohd Fadzil *et al.*, 2023). In this research, the margin calculation can be seen in Table 2.

The table above shows that the treatment groups with the largest to smallest margin contributions are respectively P0 (76,408.1), P1 (109,380.2), P3 (89,464.1), P2 (151,526.8). P2 has the largest contribution margin value compared to the other groups.

Revenue Cost Ratio (R/C)

Business feasibility or revenue cost ratio (R/C) is a comparison between total revenue and total production costs. In this research, the business feasibility of each treatment group is presented in Table 3.

Table 3. Business Feasibility (R/C) of broiler chickens for each treatment

Group	TR (Rp)	TC (Rp)	R/C
P0	196.024,10	180,240.00	1.09
P1	237,396.2	188,640.00	1.26
P2	287,942.8	197,040.00	1.46
P3	234,280.3	205,440.00	1.14

Note: TR = Total Revenue), TC = Total Cost), R/C = Revenue Cost Ratio)

The table above shows that all treatment groups (P0, P1, P2, P3) have an R/C value > 1. It can be said that all groups are worthy of being used as business examples, but specifically P2 shows a higher R/C value than the treatment group. other.

Discussion

Carcass percentage

In this study, the parameter looked at was the carcass percentage. To get results from carcass percentage, observations are needed on live weight and carcass weight. The results of research on the potential of liquid probiotics Bacillus subtilis and Bacillus coagulans show that a dose of 4 ml is

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significantly different ($p<0.05$) on carcass percentage, which can be seen in table 1. This is in line with the hypothesis in this study, namely that it is able to influence the carcass percentage in broiler chickens.

The broiler carcass percentage results in this study had an average of 62.5% for the control group, 68.2% for the P1 group, 76.7% for the P2 group, and 69.1% for the P3 group, as stated (Wahyono and Utami, 2018), that the percentage of broiler carcass varies around 65-75% of body weight. According to Fouad and El-Senousey (2014) carcass percentage is greatly influenced by final live weight, carcass weight, abdominal fat weight and fat health. The high carcass percentage is caused by the larger carcass weight obtained.

The percentage of carcass weight in treatments P1, P2, and P3 is thought to be closely related to the microbial composition in the chicken intestine. The possibility of increasing the number of Bacillus bacteria in the intestines of broiler chickens. Increasing the number of Bacillus subtilis and Bacillus coagulans in the intestine will have a positive influence on chicken growth. Lactobacillus bacteria have the ability to break down simple carbohydrates into lactic acid (Łubiech and Twarużek, 2020). As lactic acid increases, the environmental pH becomes low causing other microbes not to grow. When colonization occurs on the surface of the digestive tract, Lactobacillus prevents the growth of fungi and suppresses the growth of Escherichia coli and pathogenic bacteria in the small intestine (Jebur, 2010). Lactobacillus bacteria can maintain the balance of other bacterial populations in the small intestine.

According to Prihandini *et al*. (2020), strain, live weight, quality and quantity of feed and non-carcass weight are factors that can influence carcass weight. One of the factors that influenced this research was feed because feed changes were not made according to the needs of broiler chickens in certain growth phases. The quality of the feed provided determines its nutritional content and availability to meet the needs of broiler chickens during the rearing period (Sahraei, 2012).

Broiler chickens given a probiotic combination of Bacillus subtilis and Bacillus coagulans 4 ml orally produced the highest carcass percentage compared to broiler chickens given a probiotic combination of Bacillus subtilis and Bacillus coagulans 2 ml and 6 ml orally. At the highest dose, namely 6 ml, the increase in carcass percentage was not as large as in the P2 treatment. It is suspected that there are too many probiotic microorganisms in P3, creating conditions that are too acidic in the digestive tract. This can disrupt the stability of normal flora. An atmosphere that is too acidic can also cause the duodenal villi to be damaged, affecting the absorption of nutrients. Markowiak and Śliżewska (2017), suggested that the efficacy of probiotics is influenced by the application method, level of administration, basal feed, type of strain and probiotic concentration. Abedi and Hashemi (2020) revealed that lactic acid-producing probiotic microbes from the Lactobacillus species produce cellulase enzymes which help the digestive process. This enzyme is able to break down crude fiber components, which are difficult to digest in poultry's digestive tract.

According to Danilova and Sharipova (2020) Bacillus subtilis has the ability to produce proteolytic enzymes. Chandra *et al.* (2022), revealed that the provision of lactic acid bacteria has the potential to improve growth performance and feed efficiency. Bacillus coagulans improves growth performance and better feed utilization rates in broiler chickens by secreting the enzymes protease, a-amylase, lipidase and xylanase, as well as producing vitamins and amino acid (Zhang *et al*., 2021).

Business Analysis

According to Huerta *et al.* (2023), broiler chickens are a type of chicken that is raised for its meat, so its growth will be faster than other types of chicken, so the output level of meat production will also be faster. To find out the business analysis of broiler chicken production from the provision of liquid probiotics Bacillus subtilis and Bacillus coagulans, it is necessary to calculate related revenues and expenditures.

In this experimental model business analysis, measurements are used to determine whether a business generates profits, which are determined by three factors, according to Kesuma (2022), namely production and marketing costs, sales volume, and product selling price.

In research using liquid probiotics Bacillus subtilis and Bacillus coagulans of 2 ml, 4 ml, and 6 ml, it was shown that CM values increased at P2 but decreased at P3 as stated in table 2, this was due to the availability of liquid probiotic ingredients in excess of the requirements in the study. This and also the amount of feed consumption decreased at P3. The Total Revenue (TR) value of this research varies. This is because the total carcass yield obtained in each

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treatment varies multiplied by the selling price of chicken meat in the field using the average price for one year calculated based on kg units. The R/C value for each treatment group shows a value > 1, this shows that the research model is suitable if used as a business model, especially for P2, it has the highest value among the others, which can be interpreted as saying that the business model in P2 is very profitable.

Conclusion

Based on the research that has been carried out, it can be concluded that giving liquid probiotics Bacillus coagulans and Bacillus subtilis at doses of 2 ml, 4 ml, and 6 ml shows a real difference in carcass percentage, but at a dose of 4 ml it has a better effect than other doses on carcass percentage. broiler. Giving liquid probiotics Bacillus coagulans and Bacillus subtilis to broiler chickens at a dose of 4 ml was proven to be more beneficial than doses of 2 ml and 6 ml based on the highest CM and R/C values.

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