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Optimization of Broiler Feed Conversion Ratio by Addition of Probiotics EM-4 and Herbal

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ABSTRACT

Effective and efficient broiler management is necessary. The smaller the feed conversion ratio value, the more effective and efficient chicken maintenance. Efforts to reduce feed conversion include reducing feed consumption by adding EM-4 probiotics and herbal spices. The purpose of this study was to determine the effect of the addition of EM-4 probiotics and herbal spices on the feed conversion ratio of broiler chickens (Gallus doemesticus). Experiments were conducted using a sample of 20 broiler chickens aged 14 days, with treatments P0H0 (control), P0H1 (6g herbs), P1H0 (0.6% probiotic EM-4), P1H1 (6% Probiotic EM-4 + 6g Herbs) which were divided into four treatment groups with 5 replicates. The results showed that the treatment with 0.6% EM-4 probiotics + 6 g herbal spices had the lowest feed conversion. Then the effect of probiotics and herbal spices on broiler feed conversion rate was analyzed by Anova test, followed by Duncan test. It can be concluded that the addition of 0.6% EM-4 probiotics and 0.6% herbs is the most optimal feed ratio. These findings can help farmers, entrepreneurs or the general public who use EM-4 and herbs that can optimize their income by reducing the feed conversion ratio of broiler chickens.

1. INTRODUCTION

Broiler farms in Indonesia are increasing in number as public awareness of the importance of nutrition derived from broilers increases (Rasyaf, 2008)). According to data from the National Food Agency (Bapanas), in 2023 the average Indonesian consumes 7.46 kg/capita/year of broiler meat, an increase of 4.3% compared to 2022 (Ahdiat, 2024). Rapid growth in broilers is not only caused by genetic factors but also by external factors, such as effective and efficient maintenance (Samadi *et al*., 2020) Feed can be suppressed for effective and efficient maintenance without adversely affecting the growth and performance of broilers (Nadiya Listyasari, Soeharsono, 2022)

Feed can be a single or mixed food material, processed or unprocessed, which is given to animals for survival, production, and breeding (Daud, 2006). According to (Primacitra, Dhika Yonika, Osfar Sjofjan, 2014) ways can be done to increase feed efficiency without adversely affecting productivity, namely increasing enzymatic digestion in the poultry digestive tract, namely by utilizing probiotics.

Probiotics as a future product are used as an alternative to antibiotics and as a growth promoter containing microorganisms that support animal growth and health (Gunawan; Bagus Harianto, 2011). Probiotics play a role in limiting or killing pests and diseases, and can reduce the level of damage to livestock tissues (Izzaha et al, 2019). The use of probiotics (Feliatra, 2018) added to chicken feed can improve digestion and accelerate chicken growth, and if consumed in sufficient quantities causes increased absorption of food substances (Widiawati, Mariani Jesika, Muharlien Muharlien, 2018). In the digestive tract, probiotics can stimulate the growth and activity of certain bacteria and improve host (Wahyuni, 2019). Effective microorganism (EM-4) is a mixed

culture of microorganisms that are beneficial for plant and livestock growth used as an inoculant to increase the diversity and population of microorganisms (Palenga *et al*., 2018), which is able to optimize the utilization of food substances because the bacteria contained therein can digest cellulose, starch, sugar, protein, and fat (Yadnya *et. al*., 2014).

Feed consumption comes from the amount of feed consumed by livestock which functions to fulfill the basic life and production of these livestock (Arifin, 2014) and (Rahmawati *et. al*., 2023). Various ways are done to increase the efficiency of poultry feed use, one of which is feed additives added to animal feed (Widodo, 2017). Feed additives derived from herbal plants can replace the use of antibiotics by preventing disease in poultry so as to avoid antibiotic residues and bacterial resistance (Aidah, 2021). Probiotic natural additives can increase feed efficiency, produce healthy broiler meat, low fat but high protein criteria, and can suppress the growth of pathogenic bacteria in the digestive (Harumdewi et al., 2018). According to (Sulistyoningsih; Anas Dzakiy; Atip Nurwahyunani, 2014) herbs that can be added to chicken feed include turmeric, sambiloto, temulawak, and ginger.

Turmeric is useful as a hepatoprotector, antioxidant (*curcuminoids*), antibacterial, anti-inflammatory (essential oil), and anticancer (Supomo, 2018) and (Noor Anisah Pujianti; Achmad Jaelani; Neni Widaningsih, 2013). Turmeric added in broiler rations can improve growth and feed efficiency and as an alternative to the use of antibiotics combined with other herbal plants to get more effective results (Pertiwi; R. Murwani ; T. Yudiar, 2017). Sambiloto leaves contain andrografolid which helps increase antibody production and stimulates phagocyte cells to digest foreign microorganisms and contains flavonoids that function as growth hormones in livestock and enzyme inhibitors by forming complexes with proteins (Novia Rahayu; Nurul Frasiska, 2019). Ginger is an herb for the treatment and prevention of various (Masoud Adibmoradi, Bahman Navidshad, Jamal Seifdavati, 2006). The essential oil content in ginger helps the work of digestive enzymes so that the feed rate increases along with the growth rate which causes meat production to also increase (Ucop Haroen; Agus Budiansyah, 2018). Curcumin in ginger can improve the work of digestive organs, stimulate pancreatic sap containing amylase, lipase, and protease enzymes and even has pharmacological activities such as antibacterial, anti-inflammatory, hepatoprotector, antioxidant, immunomodulator, antihypertensive, anticancer, neuroprotector, nephroprotector, and anticoagulant. The addition of ginger extract causes higher chicken weight compared to broiler chickens without ginger (Novia Sri Hapsari; Dian Wahyu Harjanti; Anis Muktiani, 2018) and (G F Zhang 1, Z B Yang, Y Wang, W R Yang, S Z Jiang, 2009). Temulawak as an herb contains active substances xanthorrizol, curcuminoids, essential oils, proteins, fats, cellulose and minerals (Anggraini et. al., 2019) Giving herbs in feed can kill bacteria in the digestive tract of poultry (Atika Rahmah, Nyoman Suthama, 2013) & (Mustika et. al., 2022).

The amount of feed consumed by a chicken within a certain period of time to achieve optimal shape and weight is the feed conversion ratio (Supomo, 2020). The feed conversion ratio of chickens is determined from the ratio between the amount of feed used and the amount of weight gain of broilers produced (Andriyanto, 2015) and the feed conversion ratio of chickens is said to be good when the value is getting smaller (Suyasa, I.N; Parwati, 2018) and (Ridwan; Widodo ; Mukti, 2020). According to (Azizah, N. K., Sarmanu, S., Utomo, B., Sabdoningrum, E. K., Lokapirnasari, 2020) the provision of lactic acid bacteria probiotics in broiler feed can increase body weight gain by reducing feed conversion values.

Based on this description, research has been conducted on the addition of EM-4 probiotics and herbs (a mixture of ginger, turmeric, temulawak, and sambiloto) to the feed conversion ratio of broiler chickens (*Gallus domesticus*). The aim is to optimize the effect of the addition of EM-4 probiotics and herbs on the feed conversion ratio of broiler chickens so that it is useful to help farmers, entrepreneurs or the public and observers regarding the use of EM-4 probiotics and herbs in chicken feed to optimize income by reducing the conversion ratio of chicken feed.

2. MATERIALS AND METHODS

Experiments were conducted with a completely randomized design (CRD) design, using 20 ayambroiler Strain Rose 308 weighing ± 3.8 kg obtained from PT Super Unggas Jaya, 14 days old.

The research was conducted at HM Farm Candirejo Village, Wonokerso, Kedawung, Sragen. The research design used a complete randomized design (CRD), using four groups with five replicates. The feed used was GM-1 from PT CJ Cheil Jedang Indonesia, EM-4 probiotics from PT Songgolangit Persada, and herbs obtained from Pasar Bunder Sragen. The addition of herbs was 6g and the addition of EM-4 was 0.6% (Astuti et al., 2015).

Pureeing a mixture of herbs from ginger, turmeric, temulawak and sambiloto each as much as (1.5g) finely ground and then dried to get 6g of herbs to be mixed in the feed according to the treatment.

The experiment used a completely randomized design (CRD) with each group of 5 chickens (Table 1).

Table 1. Research design

	H0 (no herbs)	**H1 (with herbs)**
P0 (without probiotic EM-4)	P_0H_0	P_0H_1
P1 (with probiotic EM-4)	P_1H_0	P_1H_1

Notes:
P_0H_0 = Feeding without the addition of EM-4 probiotics and herbs (ginger, turmeric, Curcuma domestica (temulawak), dan sambiloto)
P_0H_1 = Feed + 6g Herbs
P_1H_0 = Feed + 0.6% Probiotic EM-4
P_1H_1 = Feed + 0.6% Probiotic EM-4 + 6g Herbs

The treatment was conducted on broiler chickens aged 14 days with the treatment of finisher feed. The addition of EM-4 probiotics as much as 0.6% (Astuti et al., 2015) done by spraying on the feed evenly, then fermented anaerobically.

2.1. Preparation Stage

Acclimation of DOC Strain Rose 308 was carried out for a week in a sterilized cage, equipped with 500 ml of brown sugar drinking water per drinking container and given a 65 watt warming lamp (fig.1), on the 4th day ND (Newcastle Disease) vaccine was carried out through eye drops (fig.2). The feed was GM-1 feed and drinking water for 14 days.

Fig. 1 . Broodstock Cage

Fig. 2. Providing Vaccine ND (*Newcastle Disease)*

Fig. 3. Herbal Mashing

Herbs are made from a mixture of Ginger, Turmeric, Temulawak, and Sambiloto which are mashed in the same ratio (fig. 3.) then dried and after drying mixed in the feed according to the treatment (6g). Probiotic EM-4 was sprayed on the feed evenly according to the treatment.

2.2. Implementation Stage

After 14 days of acclimation, the chickens were placed in the cage according to the treatment (4 cages, @ 5 chickens), feeding was given until day 35. The treatment began when the chickens were 14 days old, starting to be fed the treatment with the addition of probiotics and herbs according to the design until harvest (day 35).

The parameters in this study were the feed conversion ratio of chickens including the weight gain of chickens every week and the amount of feed consumption every week. Measurement of chicken weight was carried out by weighing chickens on days 22, 28, and 35, as well as measuring the remaining feed consumption on days 22, 28, and 35. The feed conversion ratio was calculated based on the amount of feed during maintenance divided by the total weight of harvested chickens

Data on chicken weight and remaining feed consumption (feed conversion ratio) were analyzed statistically using Analysis of Variant (ANOVA). This was used to analyze whether there was an effect on the conversion ratio of broiler feed after the addition of probiotics and herbs. Then to find out which one is more significant continued with the Duncan Multiple Range Test (DMRT). The research flow is presented in Fig. 4.

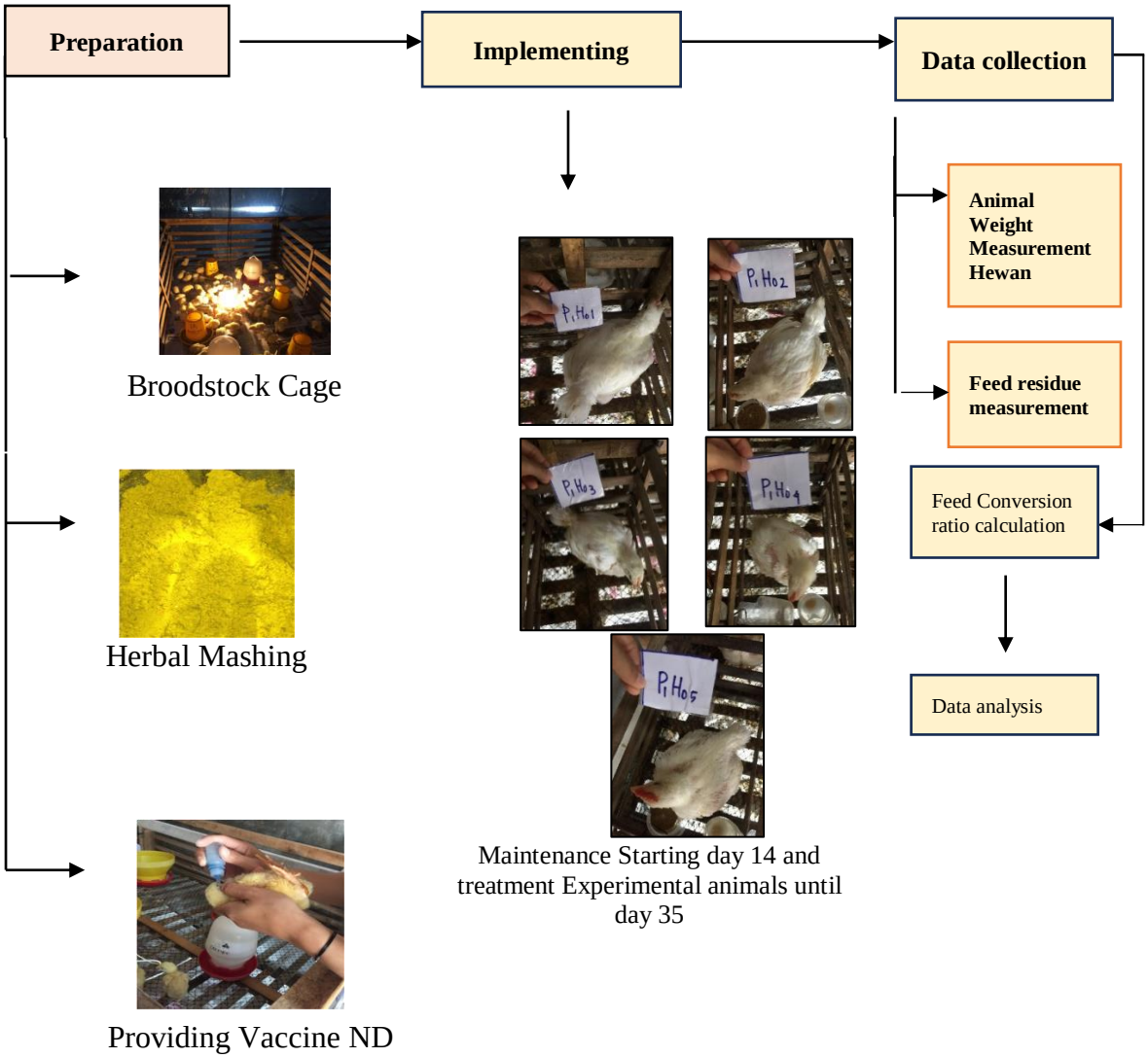

Figure 4: Research flow chart.

3. RESULTS AND DISCUSSION

Based on the rearing and feeding treatment with different probiotics until day 35 and the observations that have been made, the data in table 2 are obtained.

Table 2. Mean feed conversion ratio of broiler chickens (*Gallus domesticus*) with the addition of EM-4 Probiotics and Herbs

Treatment	Mean ± SD
P_0H_0 (Control)	$2.01^a \pm 0.23$
P_0H_1 (Feed + Herbs 0.6%)	$1.74^b \pm 0.03$
P_1H_0 (Feed + Probiotic EM-4 0.6%)	$1.63^b \pm 0.23$
P_1H_1 (Feed +Probiotics EM-4 0.6% + Herbs 6g)	$1.42^c \pm 0.18$

Notes: Different letters in the same column indicate significant differences ($p<0.05$)

Table 2 shows the feed conversion ratio of the chickens after 35 days of treatment, which showed different feed conversion ratios ranging from 2.01 to 1.42. The highest ratio was in the control (2.01) and the lowest in the treatment of feeding with the addition of Probiotic EM-4 and Herbal. Table 2 shows that the lowest feed conversion ratio was observed in treatment P1H1 (Feed + Probiotic EM-4 0.6% + Herbs 6g).

To determine whether the treatment of the addition of Probiotic EM-4 and herbs to the feed conversion ratio, the Anova test was conducted. Before the Anova test, Kolmogrov-Smirnov and Shapiro-Wilk normality tests were carried out at the $\alpha = 5\%$ level, the data were said to be normal if the value Sign. > 0.05, while the data is said to be abnormal if the value Sign. < 0,05. The results of the normality test of feed conversion ratio in broiler chickens (*Gallus domesticus*) through SPSS calculations (Table 3).

Table 3. Normality test results of broiler feed conversion ratio data (*Gallus domesticus*) with the addition of EM-4 probiotics and herbs.

	Treatment	Kolmogrov-Smirnov[a]			Shapiro-Wilk		
		Statistic	df	Sig.	Statistic	df	Sig.
Feed Conversion Ratio	P_0H_0	.4.07	5	.007	.684	5	.007
	P_0H_1	.217	5	.200*	.897	5	.394
	P_1H_0	.251	5	.200*	.868	5	.257
	P_1H_1	.317	5	.112	.749	5	.029

Table 3. shows that all treatments showed an α value of more than 5% (P>0.05), which means that the distribution of feed conversion ratio data in broilers has a normal distribution and qualifies for Anova testing, then a homogeneity test is carried out at the $\alpha = 5\%$ level to determine parametric or nonparametric analysis (Table 4).

Table 4. Homogeneity test results of broiler feed conversion ratio data (*Gallus domesticus*) with the addition of EM-4 probiotics and herbs

Lavene Statistic	df1	df2	Sig.
3.197	3	16	.052

From table 4. it can be concluded that the Sig. value is more than 5% (P>0.05), which means that the distribution of feed conversion ratio data comes from a population that has the same variance (homogeneous), so the data meets both requirements for the Anova test (table 5).

Table 5. Anova test results of data distribution of feed conversion ratio of broiler chickens (*Gallus domesticus*) with the addition of probiotics EM-4 and herbs.

	Sum of Squares	df	Mean Square	F	Sig.
Beetween Groups	.909	3	.303	13.30	.000
Within Groups	.365	16	.023		
Total	1.274	19			

The results of the Anova test (table 5.) treatment of the addition of EM-4 probiotics and herbs to the feed conversion ratio in broiler chickens (*Gallus domesticus*) showed that the Sig value. Feed Conversion Ratio < α (0.00) < 0.05) then H0 is rejected. This means that the addition of EM-4 probiotics and herbs has an effect on the feed conversion ratio in broiler chickens. In addition to the Sig. value, it can be seen from the F hit. If F hit>F table 0.5 then it can be stated that the treatment given is not significantly different. F tab0.5 obtained is 3.44 (F table). So it can be concluded that F hit> Ftab (13.30>3.44), the provision of EM-4 probiotics and herbs gives the results of a significant effect on the feed conversion ratio of broiler chickens, and to find out which treatment has the most effect, further tests are carried out, using the Duncan Test (Table 6.).

Table 6. Duncan test results of broiler feed conversion ratio data with the addition of probiotics EM-4 and herbs

Treatment	N	Subset for alpha = 0.05		
		1	2	3
P_0H_0	5			2.01[a]
P_0H_1	5		1.74[b]	
P_1H_0	5		1.63[b]	
P_1H_1	5	1.42 [C]		
Sig.		1.00	.28	1.00

Averages for groups in homogeneous subsets are shown
*using the harmonic mean of a sample with size = 5.00

Based on table 6. it can be seen that the lowest chicken feed conversion ratio is P_1H_1 (1.42) and the highest feed conversion ratio is P_0H_0 (2.01). In addition, it can be seen that there are differences in the treatment of each group of broilers, namely the P_0H_0 treatment group has no effect on the feed conversion ratio of broilers because it is located in the largest subset, the P_0H_1 and P_1H_0 treatment groups have the same effect on the feed conversion ratio of broilers, which means that the P_0H_1 and P_1H_0 treatments have the same significant effect because they are located in the same column, while the P_1H_1 treatment group (addition of probiotics and herbs) has the most effect on the feed conversion ratio of broilers because it is located in the smallest subset. Thus, the addition of EM-4 probiotics and herbal spices (P_1H_1: Feed + EM-4 0.6% + Herbal 6g) to the feed conversion ratio in broiler chickens has an effect on the feed conversion ratio of broiler chickens.

Feed conversion ratio is the result of the comparison of the amount of feed consumption with the resulting weight gain (Lestari D., Rukmiasih R., Suryati T., 2017). The lower the feed conversion rate means the better feed quality to produce body weight, in other words, the higher the feed conversion ratio value means the more wasteful use of (Ridwan; Widodo ; Mukti, 2020). Larger chickens will eat more to maintain body weight, 80% of protein is used to maintain body weight and 20% for growth so that feed efficiency will be reduced and if the feed conversion value is far above the maximum number, then the maintenance can be said to be ineffective and inefficient. Similarly, according to (Rahmawati, 2023) that the feed utilization ratio represents the

efficiency of feed utilization, the smaller the feed equivalent value, the greater the feed equivalent value.

One environmental factor that negatively impacts chicken productivity is the tendency towards high temperatures and high humidity. Such conditions exacerbate microbial growth and spoilage, which together weaken livestock immunity. Although the use of antibiotics has been shown to improve health and productivity, their use in medicine has recently been restricted due to concerns that the use of antibiotics can cause resistance to the target bacteria (Wiryawan, 2023). Some research findings suggest that the use of edible and mild ingredients such as herbal medicine (Wiryawan, 2023) can improve poultry health (Ananda et al., 2023). The addition of probiotic cultures to chicken feed has a positive impact on growth and feed utilization efficiency (A. P. Kusuma, 2014). This is in accordance with the results of research by (Hanum Shofura; Suminto; Diana Chilmawati, 2018) that the addition of probiotics to chickens at a dose of 0.4 is able to produce feed efficiency and a small feed conversion ratio of chickens. Probiotics produce a balance of bacteria that are antagonistic to pathogens, so that the digestive tract of chickens is better at digesting and absorbing nutrients in feed. Similarly, according to Saili et al. (2019) that feed containing herbal probiotics and mangrove shell extract has a significant effect on feed consumption and daily weight gain, but has no effect on feed conversion of native chickens.

Giving herbs as feed additives to broiler chickens can increase feed efficiency and animal health. This is in accordance with research (Hariyati Y., Soeparjono S., Setiyono S., 2020); (Moghaddam et al, 2021), and (Laswi Irmayanti, Jaetun Rasyid, Muhammad Nur, 2021) which states that the addition of herbs containing andrographolide and flavonoids can increase lymphocyte proliferation and increase antibodies. The same thing in (Noor Anisah Pujianti; Achmad Jaelani; Neni Widaningsih, 2013) that the addition of herbs in chicken rations has a significant effect on protein digestibility, herbs containing curcumin can stimulate bile to secrete bile and stimulate the pancreas which contains amylase, lipase, and protease which are useful for increasing the digestion of feed ingredients such as carbohydrates, fats, and proteins. Supported by (Suwarta, 2021)which explains that giving turmeric flour and sambiloto leaf powder in sufficient quantities can show good feed conversion achievements, low feed conversion values are the best values. Curcumin is widely known as a yellow pigment with a very broad role, including antioxidant prevention, anti-inflammatory, and insect control.

Similarly, it was reported (Boki, 2020) that the addition of EM-4 probiotics in fermented rations can increase feed digestibility so that it affects the daily weight gain of broiler chickens. The results of research by (Subekti E., 2015) on duck-type livestock given the addition of probiotics and herbs, showed an increase in feed utilization efficiency so that the feed conversion value decreased. Even supported by (Ananda et al., 2023) that EM-4, a probiotic containing 90 types of lactic acid bacteria (*Lactobacillus sp*.) photosynthetic bacteria (*Rhodopseudomonas sp*.), and yeast (*Saccharomycess sp*.) makes livestock healthy and useful for keeping healthy. Maintaining microbial balance in the gastrointestinal tract of broiler chickens by reducing animal stress, increasing appetite, and increasing the number of positive microbial populations. This can have beneficial effects and reduce the emergence of pathogenic microorganisms. Therefore, EM-4 probiotics as a growth stimulant can increase body weight, decrease feed conversion, and reduce the formation of abdominal fat that can affect carcass quality in broilers. Probiotics that are relatively affordable and easy to find on the market are EM4. The microorganisms contained in EM4 are fermentative and synthetic and consist of five groups of microorganisms: lactobacilli, fermentation bacteria, yeasts, photosynthetic bacteria, and actinobacteria (Rahmawati et. al., 2023).

In this study conducted at HM Farm Sragen, using broiler chickens reared from day old and started to be treated at the age of 14 days. Maintenance in the first week to the third week of each group did not show significant differences in feed consumption and weight gain. In the fourth and fifth weeks of weight gain and feed consumption there were significant differences.

The most influential treatment is the addition of probiotics and herbs at a dose of 0.6% and 6g respectively which can increase feed consumption and body weight gain, this is due to the role of beneficial microorganisms in the digestive tract, namely the effectiveness of feed consumption, so that the absorption of nutrients takes place perfectly. Probiotics and herbs can significantly increase fiber digestibility, increase body weight so that feed conversion becomes more efficient. This is in accordance with the research of (Sjofjan et al., 2020) the provision of herbs and probiotics can minimize the activity of pathogenic bacteria in the digestive system of broiler chickens.

Rahmawati et. al., (2023) stated that turmeric (herbal) is one type of phytobiotic that can increase broiler productivity and increase meat production, curcumin which is one of the active ingredients in turmeric which has broad spectrum antibacterial activity, can fight various pathogenic and non-pathogenic bacteria and has antiviral and antitumor effects. This statement describes turmeric as an effective antibiotic alternative, turmeric contains essential oils consisting of vitamin C (45-55%), zingiberene (25%), sesquiterpene ketones, turmeron (6%), borneol, chiniel, phellandrene, and sabinene (6%) and minerals Fe, P and Ca.

Based on the research that has been done, probiotics and herbs affect the feed conversion ratio in broiler chickens (Gallus domesticus). This is in accordance with (Nadiya Listyasari, Soeharsono, 2022) that the use of a combination of herbs and probiotics is effective for increasing the body weight of chickens because it causes a lower feed conversion ratio, which means a higher level of effective and efficient feed used.

4. CONCLUSIONS

Based on the research that has been done, it can be concluded that the addition of 0.6% EM-4 probiotics and 0.6% herbs affects the feed conversion ratio in broiler chickens (Gallus domesticus). These findings can help farmers, entrepreneurs or the general public who use EM-4 and herbs that can optimize their income by reducing the feed conversion ratio of broiler chickens

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