Mixture of multi-strain probiotic and ketapang leaf (*Terminalia catappa* L.) extract effects on broiler chicken performance and digestive organ weight during the finisher period

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Abstract. The aim of this study was to evaluate the effects of mixture multi-strain probiotics (MP) and katapang leaves extract (CE) on performance and digestive organ weight of broiler chickens during the finisher period. Two hundred 21-day old broiler chicken were randomly placed to the five treatments and four replicates, with ten 10 chicken each replicate. Experimental diets included a basal diet only (T1), a basal diet with 6 g/kg MP and 1 g/kg CE (T2), a basal diet with 6 g/kg MP and 1.5 g//kg CE (T3), a basal diet with 6 g/kg MP and 2 g/kg CE (T4), and a basal diet with 6 g/kg MP and 2.5 g/kg CE (T5). The variables were initial weight, live weight gain (LWG), feed intake, and feed conversion ratio (FCR) and digestive organ weight. The data were analysed using analysis of variance and the Duncan test. The results demonstrated that adding CE along with MP substantially increased LWG and improved FCR ($p<0.05$), others variables were not affected by CE supplementation ($p>0.05$). In conclusion, inclusion of 1.5 g/kg Terminalia catappa L. extract combined with 6 g/kg multi-strain probiotics significantly improved live weight gain and feed efficiency in finisher broilers, without affecting digestive organ weight. Therefore, the optimum dose rate is 1.5 g/kg Terminalia catappa L. extract with 6 g/kg multi-strain probiotics in the diet.

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1 Introduction

Probiotics are living microorganisms found in feed that stabilize gut microbiota when given in specific amounts. According to [1], live microorganisms generally have a beneficial effect on the host by enhancing the balance of the microbiota in the digestive system. Probiotics are categorized as lactic acid-producing microbes, such as Bifidobacteria, Lactobacilli, and species from the Lactobacillus group. They inhibit the growth of the diarrhea-causing E. coli bacteria [2-3]. Additionally, probiotic administration decreases intestinal infections [4] and enhances growth and ration efficiency in broiler hens [5-6]. Combining particular species of Bifidobacteria and Lactobacillus is an efficient method of altering the intestinal environment, reducing harmful bacteria and boosting good bacteria [7]. By increasing the effectiveness of nutrient uptake and utilization, these beneficial impacts can boost animal development. For instance, broiler chicken performance is positively enhanced by the administration of multi-strain probiotics [8].

Meanwhile, the use of phytobiotics can stimulate appetite, help the secretion of digestive tract enzymes, and have antibacterial activity, so it can improve the performance and health of livestock [9-10]. The administration of phytobiotics is very beneficial for broiler chickens because it inhibits pathogenic bacteria, improves digestive tract health, and can improve digestive tract function and improve immune function [10-12]. However, the effectivness of phytobiotic administration on broiler chickens will vary and depends on the biological factors of the plants used, plant species, location of the plants, the environment and conditions at the time of harvest, conditions and duration of storage [13].

The combination of the types of additives described above offers the potential for synergistic positive effects
on livestock. Prakasita [14] reported stimulation of probiotic bacterial growth when using probiotics combined with phytobiotics. Probiotics and phytobiotics are more efficient when used together than when used separately [15]. Furthermore, [16] reported an increase in the number of beneficial bacteria, suppression of E. coli populations, and increased growth in broiler chickens fed probiotics and phytobiotics. Other research has shown an increase in body weight compared to control broiler chickens [15]. Previous research has shown that administering multi-strain probiotics combined with the phytobiotic of Alisma canaliculatum has a positive effect on broiler chicken growth [17].

Ketapang (Terminalia catappa L.) is one of the plant-based phytobiotic, containing active compounds such as flavonoid and tannin. It has been reported to have antibacterial and antioxidant. The antibacterial and antioxidant qualities of the T. catappa L leaf extract however depends on plant origin, extraction process and botanical composition, resulting in different response on poultry performance. Therefore, current study will examine the effect of using a combination between multi-strain probiotics and ketapang leaves (Terminalia catappa L.) extract as phytobiotic elements on the performance and weight of the digestive organ of broiler chickens.

2 Materials and Methods

The approval of the protocols was issued by the Committee of Animal Care and Use of the Faculty of Animal Husbandry and Fishery, Tadulako University, and the approval number was 2678/UN28.16/AL.04/2025. The experiment was

carried out at the research and teaching farm of Faculty of Animal Husbandry and Fishery, Sibalaya-Sigi, Central Sulawesi.

Two hundred 21-day old broiler chicken were randomly assigned to the five treatments and four replicates, with 10 chicken per replicate. They were kept in the cages for 21 days. The wooden cages were placed in house with exposure to hot-humid environment, and equipped with drinkers and trough feeder. Basal diet mainly comprised of corn, rice bran, and soybean cake, with an 20 % protein level (Table 1), and the diet composition is as recommended by [18]. The rations and drinking water were available during the research.

Table 1. Diet composition

Ingredients	**%**
Corn	60.50
Soybean cake	17.50
Fish meal	11.50
Rice bran	9.10
Table salt	0.02
Coconut oil	0.60
DCP	0.30
Mineral-mix1	0.18
Lysine	0.10
DL-Methionine	0.20
Total	100
Chemical composition (%)	
ME (kcal/kg)	3000.43
Protein	20.21
Crude fiber	3.47

[1)] Each kg contains: Ca 0.325 kg; P 0.1 kg; Fe 6 g; Mn 4 g; I 0.075g; Cu 0.3 g; Zn 3.75 g; Vit. B12 0.5mg; Vit. D3 50,000 IU; Vit. A 1,200,000 IU; Vit. E 800 IU;Vit. K 0.2 g;Vit. B1 0.2 g; Vit. B2 0.5 g; Vit. B6 0.05 g; Vit. C 2.5 g; Ca-D-panthotenate 0.6 g; Niacin 4 g; Met.3 g;Lys. 3 g; Santoquin 1 g, and Zinc bacitracin 2.1g.

Fresh ketapang leaves (Terminalia catappa L.) were washed and were dried using an oven at a temperature of 50°C until dry, then the leaves were ground into a fine powder. After mixing 250 millilitres of 96% technical methanol with 100 grams of powdered ketapang leaves, the mixture was macerated for 24 hours. Following maceration, flannel was used to filter the mixture, separating the filtrate from the residue. A rotary evaporator machine was then used to evaporate the filtrate at 40° C and 100 mBar of pressure to get a pellet extract.

Multi-strain probiotics (MP) were purchased from the commercial market. The commercial product of MP (Lacto-Bact; PT.Sekawan Mitra Abadi) consists of Lactobacillus fermentatum (2.4x1010 CFU/g), Lactobacillus plantarum (4.5x1010 CFU/g), Lactobacillus lactis (3.6x1010 CFU/g), Bacillus coagulans (3.1 x1010 CFU/g) and Bacillus subtilis (1.7 x1010 CFU/g). Experimental diets included a basal diet only (T1), a basal diet with 6 g/kg MP and 1 g/kg CE (T2), a basal diet with 6 g/kg MP and 1.5 g//kg CE (T3), a basal diet with 6 g/kg MP and 2 g/kg CE (T4), and a basal diet with 6 g/kg MP and 2.5 g/kg CE (T5).

The parameters included initial weight, live weight gain, feed intake (FI), feed intake to live weight gain ratio (FCR), and digestive organ weight. The initial weight of the bird was recorded at the beginning and then bird's weight was

recorded weekly using a digital scale. Feed intake was recorded weekly. The acquired data was used to compute feed intake, live weight gain, and feed conversion ratios (FCRs). In order to assess the digestive organs, two birds from each experimental unit were taken out of the flock. After an 8-hour fast, they were slaughtered. Each digestive organ, including the small intestine, was carefully removed and weighed separately. The an analysis of variance and Duncan mean comparison test at $p<0.05$ based on a completely randomized design (CRD) were used to examine the collected data [19]. For the chemical analysis of feed, the proximate analysis was used [20].

3 Results and Discussion

Based on the data in Table 2, it shows that the addition of graded levels of ketapang leaves extract significantly affected the performance of broiler chickens and the increase in body weight gain of chickens in the 0.15% treatment was significantly higher than the control group ($p<0.05$), as well as the FCR was significantly lower than the control group ($p<0.05$). Other means comparison were not significant different ($p>0.05$). Other parameters were not affected by the level of ketapang leaves extract ($p>0.05$). The presence of high body weight gain in chickens accompanied by a lower value of FCR and different levels of ration consumption, proves that there is an improvement in nutrient absorption due to the addition of phytobiotics combined with multi-strain probiotics. This can be attributed to the influence of synergy between probiotics and phytobiotics. These results are agree with those reported by [15] that the use of probiotics combined with phytobiotics increased body weight gain compared to the control group. Meanwhile, [21-22] found an improvements in feed efficiency in addition to improved body weight gain. However, [23] found no significant difference in body weight gain, while [24] reported no synergistic effect resulting from the combination of plant extracts and Lactobacillus bacteria on broiler chicken growth. The differences in these research results can be attributed to differences in the types of prebiotics and phytobiotics used, as different types of probiotics and phytobiotics produce different effects [13].

Table 2. Initial weight, live weight gain, feed intake and feed conversion ratio of the bird given ketapang leaves extract and multi-strain probiotic

Variabel	Treatments					SEM	p-Value
	T1	T2	T3	T4	T5		
IW, g/bird	319.53	302.10	335.28	340.80	332.95	4.99	0.080
LWG, g/bird/day	36.07^{a}	39.17^{ab}	41.87^{b}	37.92^{ab}	37.96^{ab}	0.70	0.031
FI, g/bird/day	97.34	95.08	96.59	94.29	95.70	1.49	0.946
FCR	2.70^{a}	2.39^{ab}	2.32^{b}	2.48^{ab}	2.52^{ab}	0.05	0.047

IW: initial weight, LWG: live weight gain, FI: feed intake, FCR: feed conversion ratio,

SEM: standard error means. Different letters on the same row are significantly different

The average daily weight gain of the bird ranged from 36.07-41.87g. These values were lower than the values in the study reported by [25] with similar bird strain. This phenomenon can be attributed to the low feed intake of the bird, so that the growth was not optimal. Furthermore, the initial weight of the bird was also lower compared to the weight values in [25]. All these factors have an impact

on the FCR values. Although the FCR values of present study were affected by treatments, the best achieved value is still high compared to the ideal FCR value for broiler chickens.

The weight of digestive organ is presented in Table 3. The data indicated that broiler diets supplemented with a combination of probiotics and phytobiotic had no significant effect on the weight of digestive organs ($p>0.05$). Present study is in line with studies by [26-28]. They found that inclusion of burahol leaves (Stelechocarpus burahol) extract in broiler chicken diet produces no significant effect on the selected digestive organ [26], while [28] used moringa as a phytobiotics compound and found no effect on digestive organ weight, including ileum histomorphology of hybrid ducks. Moreover, inclusion of ketapang leaves extract in drinking water resulted in non significant effect on digestive organ of broiler chicken [27]. Similarly, boiled jengkol (Archidendron pauciflorum) peel water given in the drinking water had no effect on the digestive organ of broiler chicken [29].

In current study, the measured digestive organs showed no differences between the various levels of ketapang leaf extract administered. This is understandable because the rations provided for all treatments were identical in terms of chemical composition and physical form, resulting in relatively similar organ activity. However, the small intestine and cecum are expected to respond differently to the presence of probiotics and phytobiotics in the ration. This is related to improvements in small intestine development as reported by several previous researchers [25,30]. The addition of coconut husk extract as a phytobiotic compound, similar to ketapang leaf extract, increased villi height in all section of the small intestine of broiler chickens [25]. Multi-strain probiotics added to laying hen rations also showed improved development in all parts of the small intestine [30]. This enhancement of small intestine development was associated with a reduction in pathogenic bacteria in the intestine [26] and an increase in beneficial bacteria. All of the facts described previously will contribute to the weight gain in the digestive organs, especially the small intestine, as reported by [30].

Table 3. The digestive organ weight of the bird given ketapang leaves extract and multi-strain probiotic

Variabels, g	Treatments					SEM	p-Value
	T1	T2	T3	T4	T5		
Small	59.70	66.12	59.56	60.62	58.88	1.82	0.792
intestine	22.93	25.54	26.93	26.67	28.39	0.77	0.211
Liver							
Gizzard	34.13	29.97	33.24	35.18	33.94	0.78	0.274
Seca	7.11	7.22	6.51	7.83	7.14	0.28	0.738
Pancreas	3.75	3.68	3.86	4.63	4.04	0.23	0.716
Proventriculus	9.07	8.63	8.64	8.88	8.05	0.39	0.972

4 Conclusion

In conclusion, inclusion of 1.5 g/kg Terminalia catappa L. extract combined with 6 g/kg multi-strain probiotics obviously improved live weight gain and feed efficiency in finisher broilers, without affecting the digestive organ weight. Therefore, the optimum dose rate is 1.5 g/kg Terminalia catappa L. extract with 6 g/kg multi-strain probiotics in the diet.

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