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The Effects of Prebiotic, Probiotic and Synbiotic Supplementation on The Performance, Small Intestinal Morphometry, and Carcass Traits of Broiler Chicken

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This study aimed to investigate the effects of prebiotic, probiotic, and synbiotic supplementation on the performance, small Intestinal morphometry, and carcass traits of broiler chicken. A 160 one-day-old Cobb 500 broiler chicken was used and arranged as a completely randomized design of 4 treatment groups with 4 replicates of 10 chicken each. Supplementation was through drinking water along the experiment (28 d): P0=control, P1= prebiotic inulin, P2= commercial probiotic and P3= synbiotic mix prebiotic + probiotic and used according to the dosage of prebiotic and probiotic. One brand of commercial feed was provided, and consisted of three rearing phases was used throughout the study, and as such drinking water was provided unlimited. The parameters measured are daily feed, water intakes and weight gain. The digestibility, Gross morphometric indices of small intestine are measures of the length/weight ratio of individual segment, duodenum, jejunum and ileum and carcass traits were measured at the end day of the experiment on 3 chicken samples (lightest, average, and heaviest) of each treatment unit. The research parameters, namely feed and water intake, weight gain, feed conversion ratio, performance index, digestibility on crude protein intake, crude protein in feces, crude fiber in feces, crude protein and crude fiber, small intestine morphometry the length/weight ratio of individual segment, duodenum, jejunum and ileum and carcass traits are indicated as carcass percentage and carcass density. The effects of prebiotic, probiotic or synbiotic supplementations on parameters feed and water intake, weight gain, feed conversion ratio, performance index, digestibility, small intestine morphometry and Carcass traits were significantly affected on synbiotic supplementation compared to prebiotic, probiotic and control. The responses of body weight gain and feed conversion ratio are also indicated as the Performance Index of the supplementation synbiotic, and the synbiotic chicken group appeared a better improve performance compared to the other groups. In conclusion, synbiotic supplementation showed a better beneficial synergistic supplementation compared with those of prebiotic or probiotic supplementation separately on production performance, feed utilization efficiency, carcass traits and index performance of broiler chicken and synbiotic can significantly reduce feed use as assessed by feed conversion.

Keywords: Broiler chicken, natural growth promotors supplementation, performance index, small intestinal morphometry, carcass traits.

INTRODUCTION

In the last 2-3 decades, prebiotic, probiotic and their combinations as synbiotics have been used as feed additives, alternatives to replace antibiotic growth promoter (AGP) in livestock including poultry industry and referred as Natural Growth Promotors (NGP). Prebiotic as an alternative of antibiotic, act is defined as a selectively fermented ingredient that stimulate specific change in the microbial microbial modulator and composition, activity and/or growth of thus confers benefits upon and one or more of a limited number of beneficial intestinal microbiota the host's well-being and health (Morgan, 2013). Prebiotic inulin as one commonly used prebiotic is an oligosaccharide of plant-derived fructan,

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which has many beneficial effects on the immune system, lipid metabolism, and helps in mineral absorption and has the ability to balance the intestinal microbiota of the host (Xia *et al.,* 2019). Inclusion prebiotic inulin in the diet of broiler chicken at an early age resulted in to lower the abundances of *Bifidobacterium* and *Lactobacillus*, but it abundance subsequently increase after day 21-28, which positively correlates with body weight gain. According to the definition by FAO/WHO (2001), probiotics are live microorganisms, and also called direct-feed microbes, health and improve the growth performance of broiler chicken (Calik *et al.,* 2019) by immunomodulation, competitive exclusion of gut pathogens and by improving stability and diversity of intestinal microflora. Some beneficial microbe species belonging to, *Lactobacillus, Bifidobacterium, Enterococcus, and Streptococcus* (Jha *et al.,* 2020; Xu *et al.,* 2023). Probiotics modify the intestinal ecosystem by supplying digestion enzymes, increasing the activity of enzymes in the gastrointestinal tract and reducing pH (Song *et al.,* 2023). A study of the effects of using several combinations of three probiotic species (*Bifidobacterium lactis and Lactobacillus casei, Lactobacillus acidophilus*) on broiler chicken performance (Zhang *et al.,* 2010). The results indicated that supplementation of single strain of probiotics and their combinations prebiotic and synbiotic trough drinking water and feed improved the absorption of nutrients by increasing the activities of digestive enzymes and digestibility, improving the morphology of the digestive tract, to improve the growth performance in broilers chicken. The positive effects of combination inulin and strain of probiotics were significantly better than those of the single strain. The effect of probiotics species are in line with some other studies (Hossain *et al.,* 2022; Mirsalami and Mirsalam, 2024), abilities to form a barrier preventing colonization of pathogenic microorganism and which apparently to be necessary for adhesion to intestinal epithelial cells. When prebiotics and probiotics are used in combination, they are known as 'synbiotic. The word “synbiotic” would implies synergy, this term would be applied for those prodtheion in which a prebiotic component selectively favors a probiotic microorganism. The principal purpose of the combination is the improvement of the survival of beneficial probiotic microorganisms in the gastrointestinal tract. Advantages of both prebiotic and probiotic properties are combined to overcome some difficulties in survival of probiotic microorganisms in gastrointestinal tract and known as a synergistic effect of combination prebiotic and probiotics (Gholami-Ahangarn *et al.,* 2022). Numerous studies in broiler chicken have demonstrated that synergistically synbiotics, which are made up of prebiotics and probiotics and can be used as effective alternatives in replacing antibiotics as additives. Better outcomes of synbiotic supplementation may include better growth performance of heavier and body weight gain as well as better feed conversion ratio (FCR) (Song *et al.,* 2023). In spite of these positive effects of prebiotic, probiotic and combination prebiotic and synbiotic some other studies showed different results, that there is no significant improvement in feed efficiency and growth performance (Karunanayaka *et al.,* 2020; Bhagwat *et al.,* 2013).

The gross and histo-morphology of the small intestinal mucosa is an important determinant of the absorptive intestinal functions and digestive, which in turn determines feed utilization efficiency and the growth performance of poultry. In general, supplementation of prebiotic, probiotic, or their combinations as synbiotics showed a beneficial synergistic effects to an increase in villi height and the ratio between villi crypt depth and willy height, resulting in a larger absorptive area structure compared to that of control group, which then indicate a better gut growth performance and health (Gurram *et al.,* 2022). The negative or positive impacts of prebiotic, probiotic, and synbiotic supplementation may be indicated in absorption, digestion, lipid and metabolism of mineral and protein in broiler chicken (Dev *et al.,* 2020; Śliżewska *et al.,* 2020; Song *et al.,* 2023; Acharya *et al.,* 2014). Taking together, all these impacts would be presented in the carcass quality and production performances. Considering these positive and negative impacts of prebiotics, probiotics and synbiotic on broiler chicken, the aim of this study was to assess the individual effect of prebiotic, probiotic, and their combinations as synbiotic on the performance, the gross-morphometric of the small intestine, and carcass traits (eviscerated carcass and carcass density).

MATERIALS AND METHODS

Ethical Approve**:** The experimental protocol (IRB Protocol No. UH 102 21110720) and procedures applied in this research relating with the used animals were in accordance with and approved by Research Ethics Committee of Medical Research of the Faculty of Medicine, Hasanuddin University, Indonesia (No: 783/UN4.6.4.5.31/PP36/2023). The experiment was conducted at The Experimental Station of the Animal Science Faculty, Hasanuddin University.

Experimental Design**:** For evaluation of the effects of supplementation of Prebiotic, Probiotic and Symbiotic, a total 160 one-day-old Cobb 500 broiler chicken was used and arranged as a completely randomized design of 4 treatment groups with 4 replicates of 10 chicken each. Supplementation was through drinking water along the experiment (28 d): P0=control, water without any supplementation, P1= prebiotic/inulin (BENEO^{tm} IPS Orafi Belgium) (1 g/ L); P2= commercial probiotic (1g/L), and P3= symbiotic (mix of 0.5 g prebiotic + 0.5g probiotic /L). A commercial probiotic inulin used contained bacteria *Bacillus subtilis* (>1 x 10^8 CFU/g), *Bifidobacterium bifidum* (> 1 x $10^{8)}$ CFU/g *Bifidobacterium longum* (> 1 x 10^8 CFU/g) and *Lactobacillus bulgaricus* (> 1 x 10^8 CFU/g and used according to the dosage of prebiotic and probiotic. Each treatment unit of 10 chicken were placed in a square bamboo cage of (150 x 150 x 100) cm^3 with floor of rice husk. The chickens had free access to feed and water and monitored daily which then accumulated to along the experiment, as well as weekly body weight monitoring. There was one brand of commercial feed provided, and consisted of three rearing phases, namely BR0-crumble (1-7 d), BR1-crumble (8-21 d), and BR2-pellet (22-28 d - harvest) (Table 1).

Table 1. Nutrient specifications of different phases of the feed.

Nutrient		Feed		
		BR 0	**BR 1**	**BR 2**
Water content	Max.	14	14	14
Crude protein	Min.	22	20	19
Crude fat	Min.	5	5	5
Crude fiber	Max.	4	5	6
Phosphorus	Min.	0.5	0.5	0.45
Calcium	-	0.8-1.1	0.8-1.1	0.8-1.1
Ash	Max.	8	8	8
Aflatoxin	Min.	40	50	50
Amino acid %				
Lysine	Min.	1	1.2	1.05
Methionine	Min.	0.5	0.45	0.4
Methionine + Cystine	Min.	0.9	0.80	0.75
Tryptophan	Min.	0.2	0.19	0.18
Threonine	Min.	0.8	0.75	0.65

Source: Brochure of produced animal feed PT. Perkasa Agung Sejati.

Feed conversion ratio (FCR) were evaluated weekly because of body weight gain/feed intake. Mortality and Production Index (PI) were evaluated on the last day of the experiment. Three chickens as representative of each treatment group

***Digestibility measurements*:** After 3 days of adjustment period at the last week of the experiment, the digestibility trial was conducted in the individual metabolism cage (30 x 50 x 80 cm, equipped with feeder and water container). A selected 3 chickens of each treatment (lightest, average, and heaviest) used to determine nutrient digestibility. In the first day, feed was withdrawn for 24 h, but drinking water provided as usual. The digestibility test was conducted for 3 days in the last week of the experiment. The total feed intakes were monitored for the 1st and 2nd days and withdrawn at 3rd d, while daily excreta during 3 days consecutively were collected, weighing, preserving by spraying with 0.2N HCl, storing, and preparation for chemical analyzing (McDonald, *et al.*, 2010; Ginindza *et al.*, 2022). A proximate analysis of excreta samples during the digestibility test was done to analyze moisture, crude protein, crude fiber, ash and ether extract contents of the diet (AOAC, 2000), and the result is presented in Table 4. Apparent digestibility was calculated as follows:

Apparent digestibility (%) = [(nutrient intake - nutrient excreta)/nutrient intake] x 100

***Carcass traits and gross-morphometric indices of small intestine*:** The three chickens of each treatment group used in digestibility test were then used as representative chicken samples for examination gross-morphometric indices of the small intestine. All chicken samples were slaughtered at d 28 (4weeks old) after 12 h fasting and weighing their body weights. Carcass traits are indicated as carcass percentage and carcass density. After 5 five minutes of slaughtering-bleeding, the chicken is cleaned and immersed into hot water (50-60ºC) for 1-2 minutes, which then plucked feathers, head, eviscerated abdominal organs, and separating the small intestine from other organs. The carcass without giblets (abdominal organs) was expressed and weighed as a carcass percentage of it considered as the carcass yield and live weight (Abdel-Hafeez *et al.*, 2017). Carcass density or specific gravity was determined by weighing the carcass in air divided by carcass weight in water, which is water displacement resulted from immersing carcass (Jones *et al.*, 1978).

Gross morphometric indices of small intestine are measures of the length/weight ratio of individual segment, duodenum, jejunum and ileum. This is to reflect different functions of individual segment in absorption processes and digestion. The small intestine was aseptically emptied by gently flushed twice with isotonic saline solution to remove the luminal digest. The length (cm) and weight (g) of whole and individual segment of duodenum (from gizzard outlet to the end of the pancreatic loop), jejunum (from the pancreatic loop to Meckel's diverticulum), and ileum (from Meckel's diverticulum to the cecum junction) were sampled and measured.

***Statistical analysis*:** Data were analyzed using a statistical package of SYSTAT vs 13.2 (Wilkinson, 2009), based on one-way Analysis of Variance of a randomized completely design with GLM procedure of 4 treatments with 4 replications of 10 individual chicken per replication. For the parameters of the digestibility and intestinal morphometric indices, replication is of 3 sampled chickens. The significant differences between mean values are stated at a level of 5% maximum.

RESULTS

The effect of prebiotic, probiotic and symbiotic supplementation through drinking water on the performances of broiler are presented in (Table 2).

The results indicated that consumption of prebiotic, probiotic and symbiotic did significantly affect feed and water intakes of the chicken along the experiment. Consistently, body weight gains, feed conversion ratios, estimated digestibility of the supplemented chicken were significantly improved

Table 2. Effect of supplementation prebiotic, probiotic and synbiotic through drinking water on the water and feed intake, weight gain, feed conversion ratio and performance index in the broiler along the experiment (28 days).

Parameters	Treatment				P-value
	P0	P1	P2	P3	
Water intake (ml/bird)	2900.25±44.45[a]	2970.75±40.02[b]	3013.50±46.70[b]	3142.75±38.38[c]	*
Feed intake (g/bird)	1671.49±30.91[a]	1842.51±47.43[b]	1892.63±44.72[b]	1949.13±36.32[c]	*
Weight gain (g/bird)	1185.38±24.60[a]	1355.50±61.35[b]	1386.5 0±44.74[b]	1485.00±32.02[c]	*
Feed conversion ratio	1.41±0.020[c]	1.36±0.030[b]	1.36±0.020[b]	1.30±0.050[a]	*
Performance index	341.07±19.91[a]	361.16±12.88[b]	377.50±19.34[c]	414.63±13.81[d]	**

P0: control; P1: prebiotic; P2: probiotic; P3: synbiotic. Mean Values in the same row followed with different letters indicates significant different at level P≤0.05; *= significant different at level P≤0.05; **= highly significant different at level P≤0.01.

Table 3. Effect of supplementation prebiotic, probiotic and synbiotic through drinking water on the intakes and digestibility of crude protein and crude fiber of feces in the broiler.

Parameters	Treatment				P-value
	P0	P1	P2	P3	
Crude protein intake (g)	317.53±11.68[a]	350.07±11.52[b]	359.59±14.93[b]	370.33±12.42[c]	*
Crude protein in feces (%)*	20.70±0.65[b]	19.31±0.79[ab]	19.27±0.38[ab]	18.89±0.58[a]	*
Crude fiber in feces (%)*	11.50±0.38[a]	11.82±0.44[ab]	12.48±0.74[ab]	12.89±0.70[b]	*
Crude protein digestibility (%)	68.79±5.71[a]	74.26±5.46[ab]	75.03±3.41[ab]	79.24±1.44[b]	*
Crude fiber digestibility (%)	22.88±1.43[a]	23.96±1.30[ab]	25.16±1.08[ab]	27.31±1.82[b]	*

*Results of analysis of the feed chemistry laboratory, Faculty of Animal Science, Hasanuddin University.
P0: Control; P1: prebiotic; P2: probiotic; P3: synbiotic. Mean values in the same row followed with different letters indicates significant different at level P≤0.05; *= significant different at level P≤0.05.

Table 4. Effect of supplementation prebiotic, probiotic and synbiotic through drinking water on the length-weight ratio of individual segments of small intestine in the broiler.

Parameters	Treatment				P-value
	P0	P1	P2	P3	
Intestinal segment (%)					
Duodenum	4.68±0.49[a]	4.70±0.25[a]	4.86±0.39[a]	5.45±0.12[b]	*
Jejunum	9.36±0.18[a]	11.02±0.96[b]	11.30±0.34[b]	11.75±0.52[b]	*
Ileum	2.49±0.04[a]	2.61±0.4[a]	2.85±0.17[ab]	3.15±0.69[b]	*

P0: Control; P1: prebiotic; P2: probiotic; P3: synbiotic. Mean Values in the same row followed with different letters indicate significant different at level P≤0.05; *= significant different at level P≤0.05.

Table 5. Effect of supplementation prebiotic, probiotic and synbiotic through drinking water on the carcass percentage and carcass traits in the broiler.

Parameters	Treatment				P-value
	P0	P1	P2	P3	
Carcass percentage (%)	69.77±1.31[a]	71.13±0.95[ab]	71.60±1.96[ab]	72.26±1.90[b]	*
Carcass traits	1.038±0.011[a]	1.043±0.013[ab]	1.051±0.015[bc]	1.062±0.014[c]	*

P0: control; P1: prebiotic; P2: probiotic; P3: synbiotic. Mean Values in the same row followed with different letters indicates significant different at level P≤0.05; *= significant different at level P≤0.05.

compared to the control during the experiment. The effects of synbiotic supplementation on body weight gain appeared to be significantly more pronounced compared to prebiotic and probiotic supplementation. FCR calculation showed similar responses on body weight during the experiment. There was no mortality (live-ability= 100%) monitored of the chicken of each unit treatment during the experiment. Accordingly, production indexes of the chicken supplemented prebiotic, probiotic, and synbiotic were significantly better than those of the control chicken. Effect of prebiotic, probiotic, or synbiotic supplementation on the intakes and digestibility of crude protein and crude fiber of feces there was a significant effect (Table 3).

Gross morphometry indices of the small intestine presented as Length/Weight ratios of individual segment indicated that

there was a significant effect of prebiotic, probiotic or synbiotic supplementation on the drinking water (Table 4).
Carcass percentages and carcass density of the chicken supplemented prebiotic, probiotic, and synbiotic were significantly heavier compared to those of the control chicken (Table 5).

DISCUSSION

Effect supplementation of prebiotic, probiotic, and synbiotic to broiler chicken are for beneficial microorganisms or substrates that facilitate the growth of small intestinal microorganisms on the individual segment, which then can be harnessed as potential modulators of gut health and growth performance of the host - chicken. A lot of previous studies have reported that prebiotic improve microbial balance in the gastrointestinal tract through bacterial antagonisms, immune organ stimulation and competitive exclusion. Probiotics have also been reported to improve microbial balance in the gastrointestinal tract through bacterial antagonisms and immune stimulation. and competitive exclusion. Prebiotics which include non-digestible oligosaccharides may control or manipulate activity bacteria and/or microbial composition, thereby assisting to maintain some beneficial bacteria that suppresses through different regulatory mechanisms the growth of bacteria pathogens. The synbiotic, also referred as synbiotic may improve the survival rate of probiotics during their passage through the digestive tract, thus contributing to the enhancement and/or stabilization of the probiotic effects.
The results of the current study research indicate the effect supplementation of prebiotic, probiotic or synbiotic significantly improved feed and water intake, body weight gain, and feed conversion ratio (FCR) of the broiler chicken. In line with some previous studies (Abdel-Hafeez *et al.*, 2017; Rehman *et al.*, 2020; Biswas *et al.*, 2023) which effect that the increase in water and feed intake, body weight gain of the chicken water dietary supplementation of synbiotic were heavier than those water dietary supplementation of prebiotic or probiotic separately. The mechanism underlying the growth promoting effects of prebiotic and probiotic is unclear, but it is apparently that both prebiotic and probiotic function in modifying the intestinal microflora which then relates with function and structure of the intestine in absorption and digestibility.
Probiotic acts to maintain the dynamic equilibrium of microbiota (Kabir, 2009), while prebiotic functions to stimulate selectively the activity of colonic beneficial bacteria and growth performance (Ricke *et al.*, 2020). These beneficial effects could reduce digestive disorders and contribute to the vitality of the host-chicken and better health. Since healthy animals utilize and convert nutrients of ingested feeds effectively into constant growth, the beneficial impact of probiotic and prebiotic on the intestinal microbiota could lead to improved daily average body weight gain and feed conversion ratio.
Prebiotics used in the current study is inulin which is one of the effective prebiotics and most used (Bucklaw, 2017). Among other natural plant-derived fructans, inulin has so many beneficial effects on the helps in mineral absorption, immune system, lipid metabolism and could balance the intestinal microbiota of small intestinal animals. Inulin supplementation has been reported to promote growth performance of beneficial bacteria members of *Lactobacillus* and *Bifidobacterium* (Liu *et al.*, 2018; Xia *et al.*, 2021). This confirmed that oligosaccharides cause beneficial bacteria species to be more dominant meaning that they can competitively inhibit the growth of infected harmful bacteria, such as bacteria *Escherichia coli.*
In the current study, a commercial probiotic used contains *Bacillus subtilis, Bifidobacterium bifidum, Bifidobacterium longum and Lactobacillus bulgaricus*. These four genera-species of bacteria are commonly used as probiotics and found as communities' microbiota in the caecum. Several previous research have shown that increasing the absorption and digestion of nutrients is a major mechanism effect for the enhanced growth performance and digestibility of broilers in response to probiotic (Mohamed *et al.*, 2022; Xu *et al.*, 2023), prebiotic (Ahmed *et al.*, 2013; Morgan, 2013), or combination prebiotic and probiotic (Prentza *et al.*, 2022; Song *et al.*, 2022) supplementation. Moreover, beneficial bacteria such as *Bacillus spp, Lactobacillus spp, and Bifidobacterium spp*. are known to produce digestive enzymes which could help to improve feed conversion in host animal and enhance digestibility(Anggraeni *et al.*, 2020; Rehman *et al.*, 2020). Gastrointestinal enzyme activities such as lipase and trypsin-pepsin, amylase have an important role in nutritional digestibility, which then improves feed conversion ratio and growth performance. In current research study, the effect supplementation of prebiotics, probiotics or the combination of both may increase the activity of these enzymes on small intestines. Apparently, enzyme activities in synbiotic chicken treatment showed higher than those of prebiotic or probiotic groups. which resulted from the effect of prebiotic and probiotic supplementation.
There are well-established growth-promoting effects of prebiotic, probiotic and symbiotic, which are changes in the composition of the gut microbiota through increasing beneficial bacteria and decreasing of harmful microorganisms. In the current study, supplementation of prebiotic (inulin), probiotics (containing *Lactobacillus bulgaricus, Bacillus subtilis, Bifidobacterium bifidum and Bifidobacterium longum* or in a combination prebiotic and synbiotic may result in modulation of a beneficial microbiota, generally to increase their population, and to limit growth and attachment sites of harmful or pathogen microorganism on the intestinal surface (Fathima *et al.*, 2022**;** Zhang *et al.*, 2010). Incorporation of prebiotic and probiotic, as combination

prebiotic and synbiotic in drinking water, as in the current research study, may contribute to stimulate producing digestive enzymes, lipase and protease, such as amylase, absorption of nutrition and which may improve digestion (Song *et al.*, 2022**;** Lokapirnasari *et al.*, 2024**;** Dong *et al.*, 2024). Thus, it is not surprising that the result in the present study the efficiency of feed conversion ratio (FCR) and growth performance of the broiler group of symbiotic supplementations were significantly better than those of prebiotic or probiotic supplementation separately, as mentioned above. However, some studies reported that there was no significant improvement in feed conversion ratio (FCR) and growth performance of the broiler water diet supplemented with prebiotic, probiotic or combination prebiotic and synbiotic. The discrepancies in research may be due to differences in prebiotic, probiotics strains and conditions of environment and broiler chicken or species. Small intestine is an organ in the gastrointestinal tract where most of enzymatithebsorption and digestion of ingested nutrient of food takes place. In addition to the activities of digestive enzymes as functional responses, supplementation of prebiotic, probiotic or symbiotic may also result in modification of morphology (gross- and histo-morphology) of the small intestine. There are three segments of small intestine, which microscopically look similar, but there are some differences of important functions along the small intestine. For instance, the intestinal mucosa decreases in thickness as the crypts decrease and the vili become shorter in depth from duodenum, jejenum and ileum (Turk, 1982). The result of the current study is presented as the length/weight ratio of each segment of the small intestine (Table 3). The length/weight ratios of duodenum, jejunum and ileum increased significantly, which resulted from supplementation of prebiotic, probiotic or symbiotic. There is a dearth of reports linking the effects of nutrients supplementation and especially that of supplementation of prebiotic, probiotic or symbiotic on the length and/or weight or the length/weight ratio of the whole or individual segment of the small intestine. Alteration of the length/weight ratio of duodenum jejenum and ileum of the small intestine may be complement with alteration in growth of mucosa intestinal epithelium, including alteration in, or crypt deep (CD), villi high (VH), or villus surface area or VH/CD ratio (Marchewka *et al*., 2021; Rahardja *et al*., 2022). Alteration in the length/weight ratio of duodenum, jejenum and ileum indicate the opportunity for longer or shorter time of absorption processes and digestion, while alteration in crypt depth (CD) or villi height (VH) or villus surface area (VSA) or VH/CD ratio are an indication of mucosal thickness alteration which is associated with absorption surface area and enzymatic processes (Rahardja *et al.*, 2022). A comparison study between Ross 308 Broiler line and Lohmann dual purpose (LD) (Alshamy *et al.*, 2018) indicated that with the same body weight (but different aged achieved), LD had a significant heavier gizzard, shorter intestine, thicker ileal tunica muscularis and longer jejunal villy than those found in Ross 308. In both lines of chicken, the body weight of genetic line of the chicken had an influence on the entire intestine length ($p \leq 0.001$; adjusted $R^2 = 0.95$). The result of this comparison study indicated that alteration in the villi indices mentioned above may not alter the length of the intestine, but thicker of the intestinal mucosa of duodenum jejenum and ileum. Longer villi are usually equated with high absorptive efficiency and healthier intestinal tracts for better growth performance of the broiler chicken. The scanning electron micrograph indicated that there was no visible difference in villi density (VD) among the treatment of each individual intestinal segment on duodenum jejenum and ileum, but appears more compact as resulted from treatment of adding chicory fructans or prebiotic inulin (Yusrizal and Chen, 2003). These findings are corroborated with further results (Oliveira *et al.*, 2008**;** Izadi *et al.*, 2013**;** Alshamy *et al.*, 2018), which indicated that no difference in VD in the duodenum and jejunum was seen with the use of prebiotics and probiotics, although higher VD were seen in the ileum. Subsequently, the alteration in villus indices will initiate alteration in the thickness of the mucosal intestine (Fernando and McCrow, 1973) as resulted in increasing villus surface area–absorption capacity rather than increasing in the intestinal length. Apart from providing beneficial effects on growth performance and feed utilization efficiency, the present study also found that supplementation of prebiotics, probiotics or as a synbiotic through drinking water produces better quality and quantity of broiler carcass compared with that of the control. (Table 4). The percentage and density of the carcasses of the supplemented chicken groups were significantly higher than those of the control group, which primarily on synbiosis supplementation. The carcass percentages of the current result are in line with previous studies (Saiyed *et al.*, 2015; Abdel-Hafeez *et al.*, 2017; Rehman *et al*., 2020) which indicate that beneficial effect of the supplementation of probiotic, or probiotic or in combination as synbiotic on improving carcass percentages (dressing or evisceration). There are some possibilities of better improvement in the carcass percentage, including in visceral organs, particularly small intestine and liver (Abdel-Hafeez *et al.*, 2017). On the other hand, visible fat (around visceral organ and subcutaneous) decreased substantially (Saiyed *et al.*, 2015; Abdel-Hafeez *et al.*, 2017; Rehman *et al*., 2020) and also intramuscular fat (Cheng *et al.*, 2017). An increase in carcass density may result from a decreased fat content. Determining carcass density is a basic mean to evaluate body composition as 2 compartment model, fat mass (FM) and free-fat mass (FFM) mass of body compartments (Kleiber, 1961; Ryan and Elahi, 2007).

Taking together, it can be concluded that dietary supplementation of prebiotic, probiotic, or symbiotic trough drinking water significantly improves the production performance, feed utilization efficiency, percentage of eviscerated carcass and its density, and the length/weight ratio of individual segment of the small intestine of broiler. The responses on synbiotic supplementation may apparently result from beneficial synergistic effects of prebiotic-probiotic combination.

***Conclusion*:** The result demonstrated that Synbiotic supplementation showed a better beneficial synergistic effect compared with prebiotic or probiotic supplementation separately on production performance, feed utilization efficiency, carcass trait and index performance of broiler chicken and synbiotic can significantly reduce feed use as assessed by feed conversion.

***Authors' contribution*:** A. Acquisition of data, Doni Prawira Rahardja and A. Mujnisa Conception and design of study, Awaluddin, Djoni Prawira Rahardja and A.Mujnisa drafting the manuscript.

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