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Effects of pre-, pro-, and synbiotic supplementation on the growth performance and feed conversion rates of Indonesian native chicken – The offspring of *in ovo* L-gln fed hen

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Abstract. A research was conducted to elucidate the effect of probiotic, prebiotic and synbiotic supplementation in drinking water on the performance of Indonesian Native Chickens (INC), the offspring of *in ovo 1.5%* L-gln hens. A randomized Block Design of 4 treatments (P0=control; P1=Prebiotic (10 g Inulin in 1 l tap water); P2= Probiotic (2 g Promix in 1 l tap water), and P3=Synbiotic (10 g Inulin + 2 g Promix in 1 l tap water) with 3 times of replication blocks was used. An amount of 180 one-day-old (DOC) of INC from 3 hatching periods was used in the research, which was selected from newly hatched chicks as the offsprings of laying hen resulted from the *in ovo* L-gln. The chicks were put in brooding boxes separately for each treatment unit (maximum 15 chicks per box) and placed in a rearing room (27-28^{0}C; 60% RH). The results indicated that supplementation of pre-, pro-, and symbiotic during the first 2 weeks through drinking water did not significantly affect the body weight and feed conversion ratio (FCR) of INC; Afterward, measuring at weeks 4, 6, and 8, supplementation resulted in significantly heavier body weights and better FCR compared to those of control chicks. In conclusion, this study has shown that supplementation of pre-, pro-, and symbiotic exert positive effects on the growth and FCR of INC, and the best response is to symbiotic supplementation.

1. Introduction

There is growing interest in using a variety of pre- and probiotics to promote animal health and productivity, in broiler chicken particularly, because of increasing the bacterial resistance and decreasing acceptance of the farmer on using antibiotic - Antibacterial Growth Promoters (AGPs). Some alternatives, referred to as Natural Growth Promoters (NGPs) have been identified as effective and safe alternatives to AGPs. At present, various kinds of NGPs are available in the market, including pro-, pre, and synbiotic (mixture of pro- and prebiotics).

Some studies have suggested that synbiotics are the best option to activate the metabolism of health-promoting bacteria and/or by selectively stimulating their host's welfare and thus the growth [1-3]. The main importance of this form of synergism is that if provided a probiotic alone, without prebiotic as a source of nourishment, microorganisms in probiotics could not survive well in the digestive system. This synergism may apparently promote a better growth performance for the host.

Delivering bioactive substances, such as pro-, pre-, and symbiotic into the chicken's gastrointestinal tract, can be conducted conventionally in-feed or in-drinking water supplementation, and delivering in-drinking water appears more superior than in-feed supplementation [4].

This study was to elucidate the effects of the commercial pro-, pre- and synbiotic supplementation through drinking water on performance (bodyweight) and feed conversion rate) of INC.

2. Material and method

A research was conducted to elucidate the efficacy of supplementation of Prebiotic, Probiotic, and its Synbiotic on INC growth performance of INC, which were the offsprings of *in ovo* fed laying hen. A Randomized Block Design of 4 supplementation treatment groups consisting of: P0 (control); P1= Prebiotic (10 g Inulin in 1 l tap water),; P2 Probiotic = (2 g Promix in 1 l tap water) and P3=Synbiotic (10 g Inulin + 2 g Promix in 1 l tap water) with 3 times of replication blocks was used. Promix is a commercial probiotic contained $\pm 6.2 \times 10^8$ CPU per g, including *Bacillus subtilis, Bifidobacterium bifidum, Bifidobacterium longum, Lactobacillus acidophilus,* and *Saccharomyces cerevisiae.*

The research was conducted on 180 one-day-old INC (DOC) resulted from 3 hatching periods, which were selected from newly hatched chicks as the offsprings of the laying hen of *in ovo* L-gln fed. The chicks were weighed, fitted a wing tag, and placed in separate brooding boxes for each treatment unit (15 chicks per box), and supplementation conducted up to 4 weeks of age and placed in a room of Animal Physiology Laboratory, then continued in the animal house up to 8 weeks of age.

The chicks were fed with the commercial ration containing 21.0 g protein /kg, and 13.0 MJ metabolizable energy (ME)/kg. Food, tap water and treated water were provided ad libitum, and monitored daily, while body weights were measured 2 weekly up to 8 weeks of age.

Statistical analysis was performed using the statistical software package SPSS for Windows (version 20.0; SPSS Inc., Chicago, IL, USA). Statistical significance between mean values was set.

3. Result and discussion

The results of the research are presented in tabel 1 and tabel 2. The initial body weights among the treatment groups of selected newly hatched chicks of INC were not significantly different.

There were no significant effects of supplementation up to 2 weeks of age; The positive responses of the chicks on supplementation of pro-, pre-, and synbiotic appear after 2 weeks which is measured at 4 weeks of age, which then continues at 6 and 8 weeks of age. At 4, 6 and 8 weeks of age, the chicks supplemented with the synbiotic had greater ($P<0.05$) body weight compared to those of control chicks. Moreover, pre- and probiotic supplemented chicks had a greater body weight than those of control chicks.

Feed conversion ratio (FCR) was lower for the supplemented chicks compared to the control chicks. This response was indicated after two weeks of age. Interestingly, that FCRs of chicks supplemented pro-, pre-, and symbiotic at 4 week age were significantly lower compared to those at the other ages including the control chicks.

Growth performance, including body weight and feed conversion, is the general and direct indicator in poultry production as it involves feed utilization and overall effectiveness of poultry production. The main role of the diet is not only to provide adequate nutrition to meet the metabolic needs of the body but also to regulate various body functions. The responses of body weights and FCRs are of course due to the effects of pro, pre, or symbiotic supplementation.

Table 1. Effects of Pre-, Pro-, and Synbiotic Supplemented in drinking water on body weight of INC.

Age (week)	P0	P1	P2	P3	Sig
Newly HW (g)	31.05±3.03	31.25±3.69	31.08±3.13	31.10±3.16	P>0.05
2	77.33±5.63	79.67±7.43	80.00±6.45	79.58±6.56	P>0.05
4	206.67 ± 8.11^{a}	219.33 ± 13.21^{ab}	238.33 ± 14.67^{b}	245.67 ± 11.48^{b}	P<0.05
6	315.00 ± 24.78^{a}	329.33 ± 20.96^{ab}	342.20 ± 28.20^{b}	345.40 ± 21.69^{b}	P<0.05
8	492.07 ± 22.88^{a}	507.13 ± 23.86^{a}	514.00 ± 33.70^{ab}	540.47 ± 26.69^{b}	P<0.05

Mean within the same row with different superscripts are significantly different (P<0,05)

Table 2. Effects of Pre-, Pro-, and Synbiotic supplementation in drinking water on Feed Conversion Rate (FCR) at different ages of INC.

Age (week)	P0	P1	P2	P3	Sig
2	3.81 ± 0.72^{a}	3.61 ± 0.33^{a}	3.82 ± 0.66^{a}	3.37 ± 0.41^{a}	P>0.05
4	3.13 ± 0.36^{a}	2.69 ± 0.24^{b}	2.17 ± 0.56^{b}	2.22 ± 0.43^{b}	P<0.05
6	4.41 ± 0.67^{a}	3.50 ± 0.35^{b}	3.48 ± 0.22^{b}	3.42 ± 0.27^{b}	P<0.05
8	4.16 ± 0.37^{a}	3.26 ± 0.42^{b}	3.51 ± 0.41^{b}	3.12 ± 0.48^{b}	P<0.05
Mean	3.88 ± 0.22^{a}	3.32 ± 0.26^{b}	3.24 ± 0.35^{b}	3.03 ± 0.31^{b}	P<0.05

Mean within the same row with different superscripts are significantly different(P<0.05)

In the present study, the effects of probiotics on performance parameters of INC, body weight and FCR, are in agreements with the results of previous studies on broiler chicken that fed probiotics which resulted in improvement in growth performance and feed efficiency [5-9]. This response is thought to be induced by the effects of probiotic action including the maintenance of beneficial microbial population, improving feed intake and digestion [10], and altering bacterial metabolism [11,12]. Moreover, some characteristic effects of the immune system, decrease inflammatory reactions, prevent pathogen proliferation, reducing ammonia and urea production and excretion, and enhance animal performance. These characteristics have been investigated and mostly conducted on commercial breeds of chicken, either on broiler chicken [13,14] or laying hen [15-17].

Prebiotics interact selectively with the host to stimulate favourable microbiota in the digestive ecosystem and may have valuable effects in reducing the incidence of enteric pathogens [18]. Prebiotics has a synergistic effect with probiotics, and a systemic effect on the utilization of feed ingredient by the host, stimulation of immunity, and neutralization of toxins and they exert their action by lowering pH through lactic acid production and thus inhibiting the colonization of pathogenic bacteria [19-21].

There are three crucial elements in the gut lumen of the chicken as an ecosystem: (1) microbial community, (2) intestinal epithelial cells, and (3) immune system [22]. Prebiotic can be fermented by health-promoting bacteria (probiotic supplemented) in the intestine, producing lactic acid, short-chain fatty acid (SCFA), and some antibacterial substances, such as bacteriocin against pathogenic species [23]. These substances may not only beneficial for the intestinal microbial structure but also improve the integrity of intestinal epithelial cells, which further increase the absorption of nutrients and enhance the growth performance of chicken [24], as seen in the results of the present study reported herein.

The synergism between probiotic and prebiotic called the synbiotic would have greater benefits than using probiotic or prebiotic alone, because in the combination, the prebiotic may enhance the growth and activity of the used probiotic species [25], without prebiotic as a source of nourishment, microorganism in probiotic could not survive well in the digestive system. In the present study, INC treated with synbiotic (P3) which is a mixture between probiotic (P1) and prebiotic (P2) resulted in a significantly heavier body weight (P<0,05) and a significantly better feed conversion rate (P<0,05) compared to those of control (P0), and this performance is indicated after week 2.

Moreover, it appears that the FCR of the chicks in P1, P2, and P3 measured at week 4 were better than those measured at weeks 6 and 8, including control chicks. Some possibilities may be attributable with these results, and intriguing for further study. Firstly, functional maturity of the digestive system of INC may apparently be achieved after week 2, in spite of supplementation of pro, pre-, and synbiotic had been started soon after hatching. Secondly, the efficacy of duration, dosages, and brand or kind of supplementation via drinking water require evaluation. In the present study, supplementation was conducted up to week 4, used commercial pro-, pre-, and symbiotic with the dosages as suggested in the label.

4. Conclusion

In conclusion, the results of this study indicate that supplementations of Prebiotic and Probiotic, either alone or together as Synbiotic were responded positively by INC, which are indicated by heavier body weight and lower FCR than those of the control. These responses appeared after 2 weeks of

supplementation - measured at weeks 4, 6, and 8. An indication that symbiotic supplementation resulted in a better response of INC compared to pre-, and probiotic.

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