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Effect of Dietary Supplementation of Prebiotic and Acidifier Powder on Growth Performance and Haemato-biochemical Parameters in Broilers

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ABSTRACT

This study was undertaken during September–October, 2023 at the Department of Animal Nutrition, C.V.A.S., navania, Udaipur, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India to evaluate the effect of supplementation of prebiotics (Fructooligosaccharide) and acidifier either singly or in combination, on performance of broilers. The feeding trial was conducted on one hundred and twenty days-old broiler chicks randomly divided into three equal groups viz. C, T_1, T_2 and T_3 comprised 30 birds each, at Poultry Unit in Livestock Farm Complex. Group C served as control and received a standard broiler mash. The birds in group T_1 were fed standard broiler mash+prebiotic @ 0.5% of feed from 0–3 weeks and standard broiler mash+prebiotic @ 0.25% of feed from 4–6 weeks, T_2 were fed standard broiler mash+acidifier @ 0.5% of feed from 0–3 weeks and standard broiler mash+acidifier @ 0.25% of feed from 4–6 weeks and T_3 were fed standard broiler mash+prebiotic+acidifier @ 0.5% (1:1) of feed from 0–3 weeks and standard broiler mash+prebiotic+acidifier @ 0.25% (1:1) of feed from 4–6 weeks. The results showed that the body weight, body weight gain, daily body weight gain, average feed intake, feed conversion ratio, Hb, PCV, serum protein, cholesterol and RBC were highly significant (p<0.01) in T_3 group as compared to control group. In conclusion, the addition of FOS, Acidifier and combination of FOS with acidifier in the diet of broiler chickens improve various growth performance and hemato-biochemical parameters.

KEYWORDS: Acidifier, broiler, prebiotic, performance

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1. INTRODUCTION

Antibiotics, probiotics, prebiotics and enzymes are traditional feed additions (Abd El-Hack et al., 2022) and added to the basic feed mix or parts thereof to fulfill the specific need, usually used in micro quantities and requires careful handling and mixing (Reddy, 2022). Alternative feed additives like as prebiotics, probiotics and symbiotics can be used to improve bird performance and controlling gastrointestinal pathogens (Murate et al., 2015; Peralta-Sanchez et al., 2019). Different phytogenic feed additives have been studied to see how they enhance broiler performance, but none of them are able to substitute all of the antibiotics' functions (Choudhary et al., 2022). Prebiotic have a potential to cut food borne pathogen load in poultry (Ricke et al., 2021) and is "a substrate that is selectively utilized by host microorganisms conferring a health benefit" (Gibson et al., 2017). Prebiotics are indigestible short-chain oligosaccharide components that stimulate the growth as well as activity of the digestive system's helpful gastrointestinal microbiota (Ai-Surrayari, 2022). Prebiotics can influence the health of the host in a number of ways, including the synthesis of metabolites such lactic acid, changes to microbial metabolism and enhanced epithelial cell integrity (Neupane et al., 2019; Abd El-Hack et al., 2022; Yaqoob et al., 2021). The gastrointestinal microbiota plays an important role in nutrition, immunity and physiological systems of the broiler chicks (Oakley et al., 2014). Administration of prebiotics increases populations of lactic acid bacteria and other advantageous microorganisms in the gastrointestinal tract, that compete with pathogenic bacteria for mucosal binding sites (Patterson and Burkholder, 2003; Askelson and Duong, 2015; Broderick and Duong, 2016). Prebiotics capacity to boost lactic acid bacteria levels in the gut may help with bird's competitive exclusion of pathogens from their gastrointestinal tracts (Pourabedin and Zhao, 2015). Prebiotics have also been demonstrated to increase hen's immune responses, leading to a quicker recovery from infection (Ajuwon, 2016). For example prebiotics may interact directly with gut immune cells or indirectly with immune cells by favouring the colonization of beneficial bacteria and microb (Pandey et al., 2015). Fructooligosaccharides (FOS) are a lower-molecular-weight form of inulin that are present in perennial plants such as artichokes, chicory, onions, leeks, garlic, and asparagus (Korczak et al., 2018) and the highest concentration of FOS has been found in yacon (Caetano et al., 2016). Acidifiers in livestock nutrition give cost-effective performance enhancing options, exerting their effects through the feed, intestine and metabolism of animals (Roth et al., 2017). The activity of proteases in the gastrointestinal tract increases concurrently with an interruption in the development of gram-negative bacteria, which grow optimum at a pH of 6–7 due to acidification of its contents (Syrovatko, 2021). Dietary acidifier tends improved hematological parameters like Hb, RBC, WBC and PCV in the broiler chicks. It is generally accepted that these supplements significantly influence the microbial population in the poultry's gastrointestinal tract by depolarizing the bacterial membrane, altering its internal pH and enabling the birds to use nutrients more effectively (Heidary et al., 2018). As the uses of organic acids are becoming more acceptable to feed manufacturers, poultry producers and consumers, there is a growing interest in substituting them for antibiotic as growth promoters (Mohite et al., 2021). The prevention of intestinal bacteria from competing with the host for nutrients and the mitigation of potentially harmful bacterial metabolites are the main objectives of dietary acidification (Isfaq et al., 2015). Thus, the objective present experiment was to investigate the effect of dietary supplementation of prebiotic and acidifier powder on growth performance and hemato-biochemical parameters in broilers.

2. MATERIALS AND METHODS

2.1. Treatments and experimental designs

This experiment was conducted during September-October, 2023 after prior approval from the Institutional Animal Ethics Committee (Approved No. IAEC/RES/03/05) in the Department of Animal Nutrition, College of Veterinary and Animal Science, Navania, Vallabhnagar, Udaipur, Rajasthan University of Veterinary and Animal Sciences, Bikaner, Rajasthan, India.

The study was conducted on one hundred and twenty day-old (120), unsexed, apparently healthy broiler chicks (VENCOBB-430Y strain) of same hatch procured from Kewal Ramani Hatchery Pvt. Ltd. Ajmer, in year 2023 for six weeks, at Poultry Unit in Livestock Farm Complex of College of Veterinary and Animal Science, Navania, Vallabhnagar, Udaipur (Rajasthan). Purchased chicks were individually weighed and randomly divided using completely randomized block design into four dietary treatment groups (C, T_1, T_2 and T_3) of 30 chicks each having relatively equivalent average body weight. Each group of 30 chicks was subdivided into three replicates (R_1, R_2, R_3) having 10 chicks replicate^{-1}. The ISO certified basal feed in the form of broiler starter and broiler finisher was procured from feed distributer "Udaipur Kukkut Utpadak Sahkari Samiti Ltd.", Udaipur (Rajasthan) in required amount. Fructo-oligosaccharides and acidifier powder was obtained in dried form and stored in air tight plastic containers in Department of Animal Nutrition for further use. The proximate compositions of broiler starter and broiler finisher are showed in Table 1.

The treatment groups were as follows: C (control), was fed

Table 1: Proximate composition of broiler starter and finisher ration

Proximate principle	Starter	Finisher
1. Dry matter (%)	91.19	92.24
2. Crude protein (%)	21.50	20.18
3. Ether extract (%)	04.72	05.08
4. Crude fibre (%)	04.65	05.00
5. Total ash (%)	08.53	08.10
6. Nitrogen free extract (%)	60.60	61.64

standard broiler mash diet (BIS, 2007), T_1 was fed standard broiler mash+prebiotic @ 0.5% of feed from 0–3 weeks and standard broiler mash+prebiotic @ 0.25% of feed from 4–6 weeks, T_2 was fed standard broiler mash+acidifier @ 0.5% of feed from 0–3 weeks and standard broiler mash+ acidifier @ 0.25% of feed from 4–6 weeks and T_3 was fed standard broiler mash+prebiotic+acidifier @ 0.5% (1:1) of feed from 0–3 weeks and standard broiler mash + prebiotic+ acidifier @ 0.25% (1:1) of feed from 4–6 weeks. The acidifier combination used in the present experiment was a mixture of formic, acetic and propionic acid. Feed and clean water was supplied ad libitum.

All the chicks were kept hygienically on a deep litter system in separate pens and adopted uniform management conditions. The brooding was carried out for first two weeks by using electric bulbs. Standard vaccination schedule was followed. All birds were weighed individually at the end of each week of the experimental period (6 weeks). The weight on first day (at the start of the experiment) and 42 days of age were recorded. Feed intake per pen was recorded weekly to arrive at the average weekly feed consumption and feed conversion ratio (FCR).

2.2. Blood sample collection

At 42nd day of experimental trial, by puncturing wing vein of the brachial area, blood samples were collected from randomly selected birds in each replicate of treatment groups (six birds/treatment group), in two set of tubes viz. labeled sterile tubes containing EDTA for hematology and another tubes without anticoagulant for serology. EDTA containing tubes were analyzed for hemoglobin, red blood corpuscle count and packed cell volume with the help of an automatic hematology analyzer. Serum total protein, creatinine, cholesterol and glucose were analyzed by using commercially available kits as per mentioned protocols in the Department of Veterinary Physiology and biochemistry, College of Veterinary and Animal Science, Navania, Vallabhnagar, Udaipur.

2.3. Statistical analysis

Data collected during the present research work was subjected to statistical analysis by implementing standard methods of variance analysis as defined by statistical package for social science (SPSS), version 20. Significance of mean difference (F-values) was calculated by Dunken's multiple-range test as updated by Kramer (1956). Superscript '*' represents significant (p<0.05) and superscript '**' represents highly significant (p<0.01) difference between treatments.

3. RESULTS AND DISCUSSION

3.1. Growth performance

The effect of adding prebiotic and acidifier single or in combination on the performance of the birds is presented in Table 1. The data reveals that the average final live body weight, weight gain and daily weight gain of birds in T_3 group were significantly (p<0.01) higher than control, T_1 and T_2 group. The present observation (Table 2) is in agreement with Mohite et al. (2021) and AI-Surrayai and AI-Khalaifah (2022) who observed significant increase in body weight due to supplementation of prebiotic (FOS) powder. Similarly, the current findings are consistent with those of Ishfaq et al. (2015) and Kamal and Ragaa (2014) who found that acidifier powder supplementation of ration resulted in a significant increase in body weight broiler birds. However, Emami et al. (2012) and Malik et al. (2016) found that adding prebiotic (FOS) and acidifier powder, respectively to broiler diets had no significant effect on final live body weight.

Table 2: Supplemental effect of prebiotic and acidifier single or combination on performance of broilers

Parameters	C	T_1	T_2	T_3
Initial weight	47.90±0.69	47.57±0.34	47.40±10	47.53±19
Final weight (g)	2296.83^{a}±3.04	2651.40^{b}±46.08	2687.67^{b}±13.63	2794.50^{c}±5.66
Total body weight gain (g)	2248.93^{a}±2.48	2603.83^{b}±45.76	2640.27^{b}±13.60	2746.97^{c}±5.49
Daily body weight gain (g	53.55^{a}±0.06	62.00^{b}±1.09	62.86^{b}±0.33	65.40^{c}±0.13
Total feed consumption (g)	4262.59^{a}±13.34	4552.70^{b}±26.46	4571.67^{bc}±13.96	4630.74^{c}±18.02
Average feed conversion ratio	1.89^{c}±0.01	1.75^{b}±0.03	1.73^{ab}±0.01	1.69^{a}±0.01

All values are represented as Mean±SEM; n=30 in each group; means bearing different superscript in the same row differ significantly between groups at p<0.05

The present findings were similar with Taherpour and Ghasemi (2014) in broiler birds supplemented with a combination of prebiotic and acidifiers. However, Emami et al. (2012) and Saheh et al. (2014) found that adding prebiotic and Heidari et al. (2018) and Seifi et al. (2015) found that adding acidifier non-significant effect on body weight gain of broilers.

The present findings regarding average daily body weight gain are in accordance with findings of Xu et al. (2003) and Li et al. (2008) who observed significant effect of prebiotic powder in broilers. Similarly, Dizaji et al. (2012) found significant increase in daily body weight gain of chicks in group fed acidifier powder (Table 2).

The average feed consumption of birds of the experimental groups, T_3 group has higher comparable with C, T_1 and T_2 group. Present findings (Table 2) are in agreement to the findings of Saleh et al. (2014) and Youssef et al. (2017) who reported significant effect on feed consumption due to supplementation of prebiotic and acidifier powder respectively. However, contradicting the findings of the present study, Taherpour and Ghasemi (2014) reported non-significant (p>0.05) effect on feed intake due to fed of prebiotic with acidifier combination.

The feed conversion ratios in feed intake per unit gain in weight for the birds from group T_3 were significantly higher than control, T_1 and T_2 groups (Table 2). The present study results agree with Williams et al. (2022) and Youssef et al. (2017) who reported significantly better FCR by addition of prebiotic and acidifier in diet, respectively. However, Kim et al. (2011) and Heidari et al. (2018) observed non-significant effect (p>0.05) on FCR in broiler birds supplemented with prebiotic and acidifier respectively in broiler diet.

3.2. *Hemato-biochemical parameters*

The effect of prebiotic and acidifier powder supplementation on haemato-biochemical parameters of broiler chicks has been presented in Table 3.

Highly significant (p<0.01) effect of prebiotic and acidifier powder meal in diets of broiler chicks on Hb, RBC, PCV, serum protein and cholesterol at 42 day of age in broilers were observed. The effect of supplementation of prebiotic and acidifier powder as feed additive in ration of broiler chicks in respect to hemato-biochemical parameters, were found to be non-significant (p>0.05) on glucose and creatinine at 42 day of age (Table 3).

The present results well collaborate with the findings of Saha et al. (2010) who reported significant effects on haemoglobin, PCV and RBC in broilers fed prebiotic (FOS) powder in their diets. Similarly, who reported significant effect on haemoglobin, PCV and RBC due to addition of acidifier powder in broiler diets. Syrovatko, (2021) found significant effect on haemoglobin and RBC due to addition of acidifier powder in broiler diets. Contrary to the present (Table 3) findings Solanki et al. (2020) reported non-significant effect (p>0.05) on hemoglobin, PCV, total protein and cholesterol concentration in the broiler birds due to the supplementation of the prebiotic and acidifier powder in their diets. AI-surrayai and AI-Khalaifah (2022) reported non-significant effect (p>0.05) on hemoglobin, red blood cell and packed cell volume.

Results of the present study (Table 3) are in accordance with Ashaverizadeh et al. (2009) reported non-significant effect on blood glucose level of broilers due to supplementation of prebiotic powder in broiler diets. Solanki et al. (2020) and Syrovatko (2021) recorded non-significant effect on serum total protein, glucose and cholesterol due to supplementation of acidifier powder in broiler diets. In contrast to the present findings, Brzoska et al. (2013) and Seifi et al. (2015) observed significant difference of acidifier powder supplemented groups in blood glucose and cholesterol as compared to control group.

Table 3: Supplemental effect of prebiotic and acidifier single or combination on hemato-biochemical parameters of broiler chicken

Parameters	C	T_1	T_2	T_3
Hb (gm %)	9.19^{a}±0.02	9.55^{b}±0.18	9.69^{b}±0.05	10.76^{c}±0.03
PCV (%)	27.15^{a}±0.29	28.70^{b}±0.04	29.44^{c}±0.10	30.48^{d}±0.26
RBC (million mm cube^{-1})	2.64^{a}±0.02	2.73^{ab}±0.04	$2.76b^{c}$±0.03	2.85^{c}±0.01
Glucose (mg dl^{-1})	218.11±0.14	218.04±0.87	217.55±1.21	217.05±0.38
Serum Protein (g dl^{-1})	2.41^{a}±0.02	2.64^{b}±0.06	2.66^{b}±0.01	2.81^{c}±0.02
Cholesterol (mg dl^{-1})	126.79^{c}±0.10	124.21^{b}±0.19	123.57^{b}±0.14	122.01^{a}±0.47
Creatinine (mg dl^{-1})	0.41±0.00	0.39±0.00	0.40±0.00	0.39±0.01

All values are represented as Mean±SEM; n=30 in each group; means bearing different superscript in the same row differ significantly between groups at p<0.05

The current results well collaborate with the outcomes of Brzoska et al. (2013) and Sarvari at el. (2015) who reported significant effect on serum protein due to addition of acidifier powder in broiler diets. In oppose to the above mentioned results (Table 3), Abdel-Raheem et al. (2011) found non-significant difference in total protein in serum due to dietary supplementation of prebiotic powder in broiler diets.

In congruence to results of current study (Table 3), Fallah et al. (2013) observed significant effect on serum cholesterol levels due to the supplementation of prebiotic plus acidifier powder. Similarly, the results of Heidari et al. (2018) observed significant effect on serum cholesterol levels due to the supplementation of acidifier powder. However, in conflict of the present study results, Solanki et al. (2020) and Syrovatko (2021) found non-significant reduced (p>0.05) in serum cholesterol levels by the addition of acidifier powder in the broilers.

The present results (Table 3) are favorably compared with the findings of Youssef et al. (2017) who reported non-significant changes in the creatinine levels of the broiler birds fed acidifier powder as the dietary supplement.

4. CONCLUSION

Addition of prebiotic and acidifier supplementations to broiler diets improved the growth performance, haemato-biochemical parameter like Hb, PCV, RBC, total protein and decreased serum cholesterol level of the broilers at 42 days of age.

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