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Research Article

Effect of prebiotic alternative to antibiotics in ration on meat quality parameter and cooking properties of broiler meat

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Abstract

The research was conducted to investigate the effect of prebiotic on nutritional composition and cooking properties of broiler meat. 120 Habbard classic broiler male chicks were divided at random into five dietary treatment groups, each with three replications of eight chicks. The dietary treatment included T_1= None of prebiotic or antibiotic; T_2= 50mgantibiotic/kg of diet; T_3=0.5g of prebiotic/kg of diet; T_4= 1g of prebiotic/kg of diet and T_5= 2g of prebiotic/kg of diet during the entire period. The commercial name of this prebiotic is AGREMOS. The T_5 treatment group recorded the highest length and diameter of the drumstick (129.95mm and 63.49mm), while the T_2 and T_1 dietary groups recorded the lowest length and diameter of the drumstick (129.07mm and 40.81mm, respectively). Prebiotic significantly ($p<0.001$) affects the diameter and length of various broiler body parts as well as their weight (aside from dressing and feathers), drip loss, cooking loss, and cooking yield. CP%, EE%, Ash% of drumsticks and DM%, moisture%, and CP% of breasts were significantly ($p<0.001$) affected by prebiotic. For drumsticks, the dietary group T_5 had the highest CP% and EE% at 27.86 and 2.63, respectively, while T_1 and T_3 had the lowest values at 24.01 and 2.47. In terms of breast muscle, T_5 had the highest CP% (27.86) and T_1 had the lowest CP% (24.01). Prebiotic is an excellent substitute for antibiotics in broiler diet. When compared to the other treatments, it was discovered that treatment T_5 (2g prebiotic) was superior for the diet of broilers.

Introduction

In addition to being crucial in human medicine, antibiotics are used in the production of poultry. Antibiotic resistance is likely to develop faster in pathogens and commensal organisms if such vital antimicrobials are used carelessly in animal production. Antibiotics have long been added to poultry feed as growth promoters to stabilize the intestinal microbial flora, boost production performance, and guard against some specific intestinal pathogens (Azad et al., 2022; Miles et al., 1984; Waldroup et al., 1985). This would lead to unsuccessful treatments, financial losses, and could serve as a gene pool source for human transmission. The presence of antimicrobial residues in meat, eggs, and other animal products also raises concerns for human health (Mirlohi et al., 2013). It is believed that environmental pollutants, such as antibiotic residues, antibiotic-resistant bacteria, and resistance genes, are to blame for the global public health crisis (Xi et al. 2009).

Prebiotics can increase food utilization, which lowers nutrient excretion (Traldi et al., 2007). Additionally advantageous effects of dietary prebiotics include enhanced epithelial cell integrity, enhanced immune response, balanced gut micro flora, and improved utilization and digestion of diet (Nepomuceno and Andreatti, 2000). Mannose, a major component of carbohydrates, is typically found in prebiotics. These products are frequently used to lessen enteropathogenic bacteria's ability to colonize the gastrointestinal tract. Mannan-oligosaccharides (MOS) and fructo-oligosaccharides (FOS), which are found in the cell walls of yeasts like Saccharomyces Cerevisiae, make up the majority of prebiotics (Shandare et al., 2008). Very scanty scientific information about nutritional composition and cooking properties of broiler meat is available regarding the utilization of prebiotic in the diet of broiler ration instead of sub-therapeutic doses of antibiotic in Bangladesh. With the view of justification, the research was conducted with the following of objectives: to assess the carcass yield, meat quality and cooking properties of broiler meat.

Methodology

Samples were collected from a reputable hatchery, and 120 Habard Classic day-old chicks were used as samples. The birds were all male in gender.

Design of the Study

The study was conducted with Completely Randomized Design having five treatments and three replications of eight birds each. The dietary treatment included T_1= None of prebiotic or antibiotic; T_2= 50mgantibiotic /kg of diet; T_3= 0.5g of prebiotic/kg of diet; T_4= 1g of prebiotic/kg of diet and T_5= 2g of prebiotic/kg of diet during the entire period. The commercial name of this prebiotic is AGREMOS.

Collection of Data

Data was collected at a regular basis according to the parameter to be investigated. Parameters studied were carcass yield, body part yield (breast, leg, back, wings and thigh meat.) drip losses and cocking losses. Proximate composition was determined (AOAC, 1995).

Management Practices

The management was performed according to the Habard Classic broiler rearing manual supplied by the hatchery and executed with the help of Nutritionist, Poultry specialists and Veterinary doctor. The birds were randomly assigned to each pen, and the house was divided into sections by wire net. The stocking density, excluding the feeder and waterer, was about 9 birds per square meter. In each pen, there were two feeder troughs measuring (90cm, 11.5cm, and 6cm) and two pot drinkers, each with a 3-liter capacity. The same feeder and 4-liter drinkers were used in each pen for 8 birds after 4 to 6 weeks. At a depth of approximately 5 cm, fresh, dried sawdust was used as litter.

The room's initial temperature was 34°C, and by the third week, it had gradually dropped to 29°C. Throughout the research period, the birds were continuously exposed to 18 hours of light and 6 hours of darkness. During the trial period, strict sanitation procedures were maintained in accordance with the guidelines in the manual.

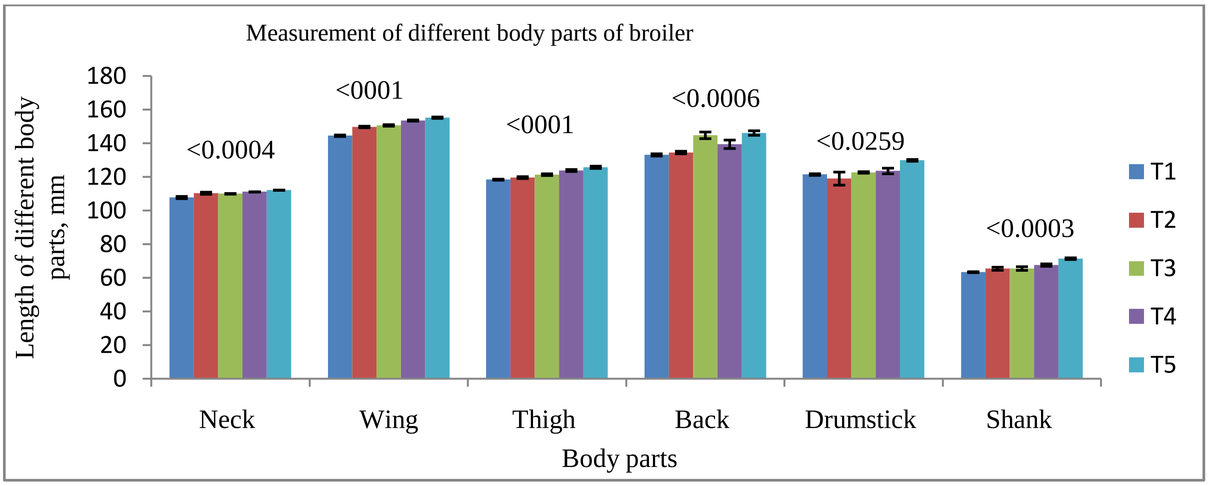
Data analysis

All acquired data were compiled and evaluated by employing General Linear Model (GLM) procedures of SAS Institute (SAS, version 9.4,1996) with $p<0.05$ level of significance. The Duncan's Least Significance Difference test was carried out to determine the significant difference among treatment groups.

Result and Discussion

Measurement of different body parts of broiler

Figure 1 showed that prebiotic had a significant effect ($p<0.05$) on the neck length. The highest neck length was 112.20 mm in T_5 while the lowest neck length was in 107.82mm in T_2 dietary feed group. The prebiotic had also significant effect ($p<0.0001$) on the length of wing and thigh. The highest length of wing and thigh was 155.29 mm (T_5) and 125.79 mm (T_5) while the lowest length was144.56 mm (T_1) and 118.44mm (T_1), respectively. Prebiotic had also significant effect ($p<0.0259$) on drumstick; the highest and lowest length of drumstick was 129.95mm (T_5) and 119.07 mm (T_2), respectively.



T_1 = No prebiotic and no antibiotic; T_2= Antibiotic (50mg); T_3= 0.5g of prebiotic; T_4 = 1g of prebiotic and T_5= 2g of prebiotic

Figure 1. Comparison of different body parts of broiler among the treatment groups.

In the present experiment prebiotic had highly significant effect ($p<0.0001$) on the live weight gain that was showed in Table 1. The highest live weight was 2.60 kg (T_5) while the lowest live weight was 2.12 kg (T_1). Similarly, prebiotic had a highly significant effect ($p<0.0001$) on dressing weight, head wt. ($p<0.001$), heart wt. ($p<0.001$), lung wt. ($p<0.001$), liver wt. ($p<0.001$), shank wt. ($p<0.0001$) and intestine wt. ($p<0.0001$) and proven triculus wt. ($p<0.0001$). The highest dressing weight was 1.88kg (T_5) while the lowest dressing weight was 1.48kg (T_1). Prebiotic had significant effect ($p<0.05$) on gizzard wt. The highest gizzard weight was 75.33g (T_5) while the lowest gizzard weight with 69.77 g (T_3.).In the present study, probiotic had a significant effect ($p<0.005$) on the liver weight of the broiler birds and the effect was maximum in case of birds treated with low level (T_2) of dietary prebiotic group. Different management and environmental factors of the present study might play a significant role in this disagreement with Bozkurt et al. (2008). Shendare et al. (2008) stated that supplementation of prebiotic (Mannan-oligosaccharide and β-glucans) influence the achievement of higher live weights of broilers. These results were almost similar to the present study.

Table 1. Weight of different body parts of broiler (Mean ±SE)

Parameter (weight)	T_1	T_2	T_3	T_4	T_5	p value
Live wt. (kg)	$2.12^{d}\pm0.02$	$2.48^{b}\pm0.02$	$2.38^{c}\pm0.02$	$2.42^{bc}\pm0.01$	$2.60^{a}\pm0.01$	<.0001
Dressing wt. (kg)	$1.48^{c}\pm0.02$	$1.79^{ab}\pm0.05$	$1.74^{b}\pm0.03$	$1.72^{b}\pm0.02$	$1.88^{a}\pm0.00$	<.0001
Dressing %	$69.59^{b}\pm0.21$	$72.09^{ab}\pm1.50$	$72.97^{a}\pm0.93$	$71.15^{ab}\pm1.20$	$72.33^{ab}\pm0.15$	0.1968
Feather wt. (g)	419.68±1.40	420.64±5.70	418.06±1.62	420.31±3.97	428.23±1.31	0.2936
Head wt. (g)	$54.27^{c}\pm 0.48$	$59.40^{b}\pm0.42$	$59.65^{b}\pm1.63$	$57.11^{b}\pm 0.48$	$62.95^{a}\pm0.32$	0.0003
Gizzard wt. (g)	$71.55^{b}\pm0.81$	$73.23^{ab}\pm 0.81$	$69.77^{b}\pm0.81$	$72.42^{ab}\pm1.77$	$75.33^{a}\pm0.70$	0.0410
Heart wt. (g)	$13.08^{c}\pm 0.31$	$14.75^{b}\pm0.38$	$13.29b^{c}\pm0.70$	$16.88^{a}\pm 0.19$	$17.70^{a}\pm0.64$	0.0001
Lung wt. (g)	$12.05^{d}\pm 0.51$	$14.01^{bc}\pm0.15$	$13.37^{c}\pm0.39$	$14.81^{b}\pm 0.27$	$16.17^{a}\pm0.20$	<.0001
Liver wt. (g)	$35.45^{e}\pm0.45$	$38.70^{d}\pm 0.31$	$44.54^{c}\pm0.32$	$47.82^{b}\pm1.03$	$51.23^{a}\pm0.66$	<.0001
Shank wt. (g)	$18.64^{d}\pm0.35$	$21.00^{c}\pm0.57$	$22.16^{b}\pm0.10$	$23.00^{b}\pm0.31$	$24.12^{a}\pm0.13$	<.0001
Intestine wt. (g)	$79.35^{c}\pm00.72$	$80.19^{c}\pm0.65$	$85.00^{b}\pm 0.57$	$83.93^{b}\pm1.89$	$90.13^{a}\pm 1.08$	0.0003
Proventriculus wt. (g)	$8.84^{c}\pm0.12$	$9.92b^{c}\pm0.36$	$9.55^{bc}\pm0.32$	$10.23^{b}\pm0.49$	$13.09^{a}\pm0.24$	<.0001

T_1 = No prebiotic and no antibiotic; T_2= Antibiotic (50mg); T_3= 0.5g of prebiotic; T_4 = 1g of prebiotic and T_5= 2g of prebiotic

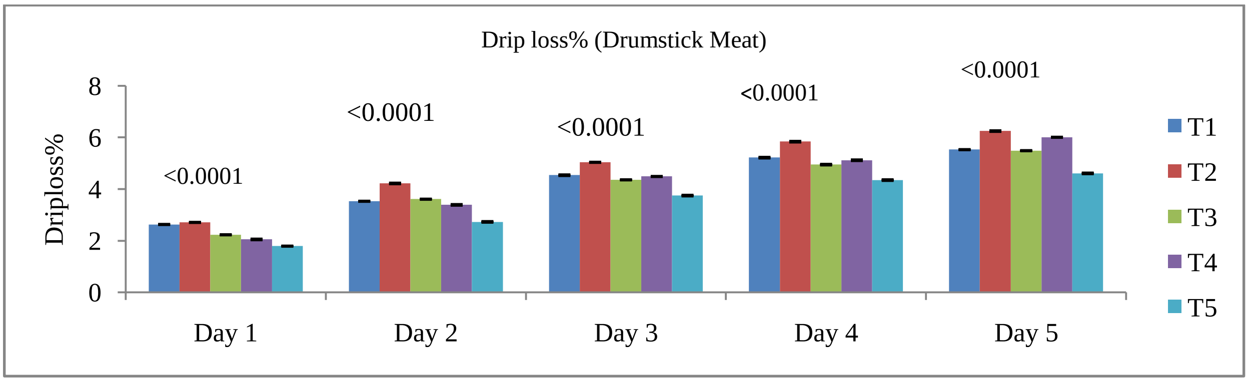
Proximate composition of broiler meat is shown in Table 2. In drumstick, dietary prebiotic had a highly significant effect ($p<0.0001$) on CP% and EE %. It is shown that the highest CP% and EE% was 25.06 in T_3 and 2.63 in T_5, respectively while the lowest CP% and EE% was 20.75 in T_1 and 2.47 in T_3. But there was no significant effect ($p>0.05$) of prebiotic on the moisture % and DM% of meat of different dietary prebiotic treatments. In Table 2, in breast muscle of broiler meat, prebiotic had a significant effect ($p<0.001$)on moisture%, DM% and CP%. The highest value of moisture, DM and CP% was 77.82% with T_1, 37.68%in T_4 and 27.8 in T_5, respectively. Whereas the lowest value of moisture, DM and CP% were 62.31% in T_4, 22.18% in T_1 and 24.01% in T_1. Different managements as well as environmental factors may affect the CP% of broiler meat. So, the present study states that prebiotic plays a significant role in the CP% of the broiler birds. Das et al. (2022) found CP 22.61% which is similar to the current findings.

Table 2. Proximate composition of broiler meat (Mean ±SE)

Parameter (%)(Drumstick meat)	**T_1**	**T_2**	**T_3**	**T_4**	**T_5**	**p value**
Moisture	76.87±1.79	73.42±1.46	75.03±0.95	76.71±0.65	76.22±0.86	0.3059
Dry matter	23.12±1.79	26.58±1.46	24.96±0.95	23.28±0.65	23.77±0.86	0.3059
CP	20.75^{d}±0.27	23.04^{b}±0.20	25.06^{a}± 0.19	21.88^{c}±0.32	23.41^{b}± 0.37	<.0001
EE	2.16^{b}± 0.03	2.13^{b}± 0.07	2.47^{a}±0.05	2.62^{a}±0.05	2.63^{a}±0.04	<.0001
Ash	1.09^{bc}± 0.01	1.05^{c}± 0.01	1.17^{a}± 0.01	1.13^{ab}±0.02	1.11^{ab}± 0.01	0.0050
(Breast meat)						
Moisture	77.82^{a}± 1.93	69.39^{bc}± 3.40	67.41^{bc}±2.32	62.31^{c}±0.91	73.96^{ab}±1.59	0.0049
Dry matter	22.18^{c}±1.93	30.61^{ab}± 3.40	32.58^{ab}±2.32	37.68^{a}±0.91	26.03^{bc}±1.59	0.0049
CP	24.01^{b}±0.27	27.21^{b}±0.37	27.22^{a}±0.25	26.36^{a}±0.31	27.86^{a}±0.37	0.0001
EE	1.37^{b}±0.02	1.42^{ab}±0.06	1.42^{ab}± 0.09	1.59^{a}±0.02	1.43^{ab}±0.02	0.1283
Ash	1.27±0.02	1.18±0.03	1.21± 0.02	1.20±0.02	1.22±0.04	0.4520

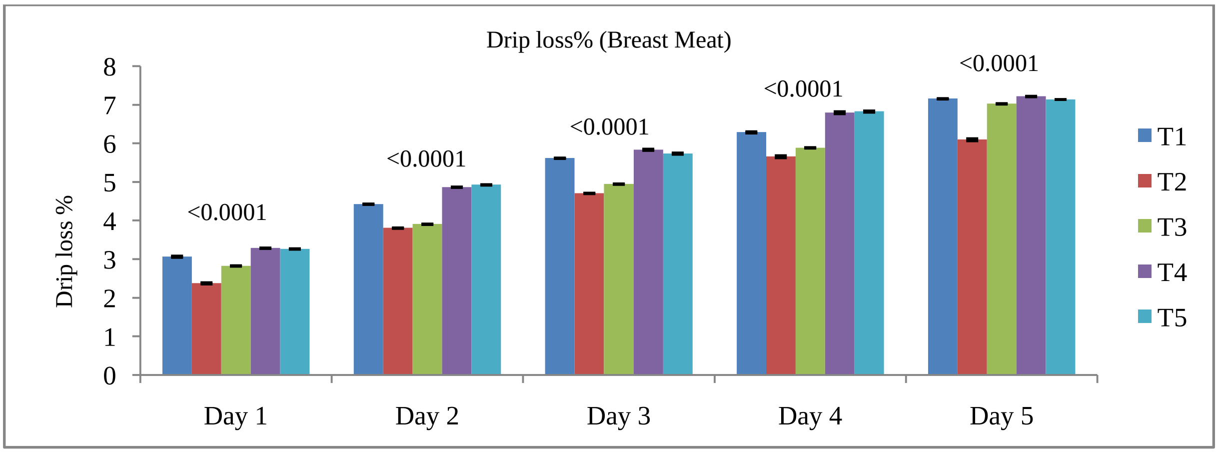
T_1 = No prebiotic and no antibiotic; T_2= Antibiotic (50mg); T_3= 0.5g of prebiotic; T_4 = 1g of prebiotic and T_5= 2g of prebiotic

Drip loss of broiler meat is shown in Figure 2 and Figure 3. In case of drumstick, prebiotic has high significant effect ($p<0.0001$) on drip loss from day one to day five. From day one to five, highest and lowest drip loss was 6.25% in T_2 and 1.79% in T_5. Similarly, in case of breast meat, prebiotic had also significant effect ($p<0.0001$) on drip loss between day one to day five. From day one to three, highest drip loss was 5.84% in T_4. From day four to five, highest and lowest drip loss was 7.22%in T_4 and 6.10% in T_2. Rahman et al. (2022) found drip loss 3.36% which is within the range of current findings.



T_1 = No prebiotic and no antibiotic; T_2= Antibiotic (50mg); T_3= 0.5g of prebiotic; T_4 = 1g of prebiotic and T_5= 2g of prebiotic

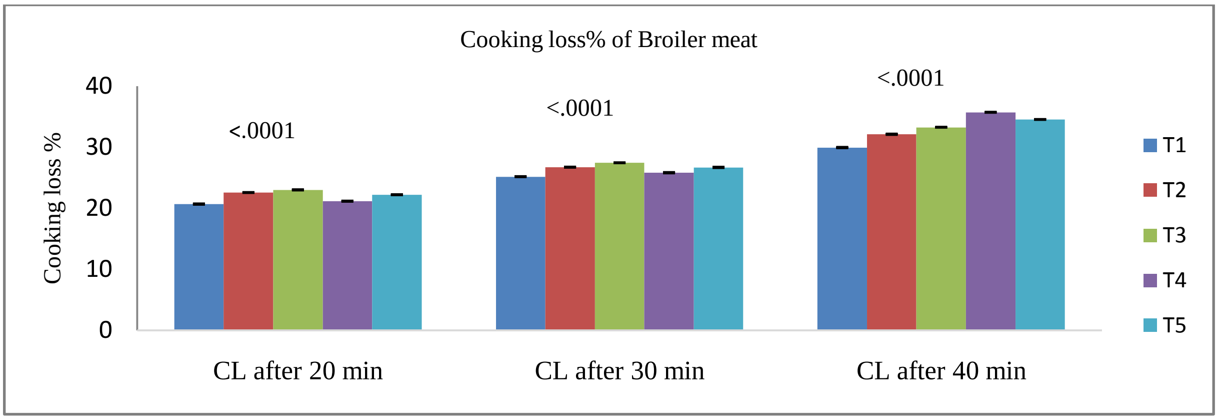
Figure2. Drip loss percentage (%) of broiler meat (Drumstick).



T_1 = No prebiotic and no antibiotic; T_2= Antibiotic (50mg); T_3= 0.5g of prebiotic; T_4 = 1g of prebiotic and T_5= 2g of prebiotic

Figure 3. Drip loss percentage (%) of broiler meat (Breast).

Cooking loss of the meat is presented in Figure 4. The samples were analyzed after 20 minutes, 30 minutes and 40 minutes of cooking followed our traditional time of cooking either urban area or in remote village area. The cooking loss of chicken meat was highly significant ($p<0.001$) in all the treatments. After 30 minutes and 40 minutes of cooking, the highest value was found in T_3 (27.43%) and T_4 (35.71%) and the lowest value was found in T_1 (25.17%) and T_1 (29.93%), respectively. Ali et al. (2022) found cooking loss was 23.08% which is lower from the present findings.



T_1 = No prebiotic and no antibiotic; T_2= Antibiotic (50mg); T_3= 0.5g of prebiotic; T_4 = 1g of prebiotic and T_5= 2g of prebiotic

Figure 4. Cooking loss percentage (%) of broiler meat.

Conclusion

It might be concluded that prebiotic has significant effect ($p<0.05$) on different aspects like body parts, proximate composition, drip loss, cooking yield and loss etc. of broiler meat. In this research on the basis of discussion stated above, 2g of prebiotic in the broiler diet might play an important role regarding broiler meat quality parameters and cooking qualities. So, prebiotic might be a good alternative to antibiotics in broiler diet.

Conflicts of Interest

The authors declare that there are no potential conflicts of interests.

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