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Effects of Formic Acid Supplementation at Incremental Levels on Growth Performance and Carcass Traits of Broiler Chickens

Research

KEYWORDS : formic acid, broiler chickens, performance, carcass traits

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ABSTRACT

The effects of inclusion of formic acid at incremental dose levels in the diet of broiler chickens were studied in this experiment. A straight-run flock of 2000 1-d old Cobb 400 chicks were assigned randomly into five dietary treatments each with four replicates (n= 100 chicks per replicate). The diets were iso-caloric and iso-nitrogenous and consisted of a corn-soybean based basal diet (T0), T0 supplemented with formic acid at the rate of 1% (T1), 1.5% (T2) and 2% (T3) at the expense of maize. Supplementation of formic acid at 1.5% and 2% dose rates improved (P<0.05) live weight gain at d 21 and d 42 and also resulted in superior feed conversion ratio at the respective ages. Better (P<0.05) dressed weight was obtained for T2 as compared with T0, T1and T3 groups of birds. Findings of this experiment suggested that formic acid supplementation at a dose rate of 1.5% as well as 2% in the diet of broiler chickens is advantageous to obtain improved growth performance and carcass yield.

INTRODUCTION

The use of antibiotics as routine feed additives has been banned in the recent years owing to the human health hazards caused by their residual effects and development of drug resistant bacteria [1]. Therefore, research has been focused on development of alternatives to antibiotic growth promoters (AGP) to maintain health and performance of poultry. Application of non-antibiotic chemical substances like organic acids may be one of such alternatives [2]. The present study was conducted to evaluate the effects of incremental levels of formic acid in diet on growth performance and carcass characters of broiler chickens.

MATERIALS AND METHODS

Bird husbandry: A straight run flock of 2000 1-d-old Cobb 400 broiler chickens (43.5±1.19 g) were assigned to five dietary treatments for 42 days. Each treatment group had four replicates with 100 birds in each replicate. The replicates were placed in pens (3.2m x 3.2m) on litter made up of saw dust and wood shavings. All birds were vaccinated against Newcastle disease (d 6 and 19) and infectious bursal disease (d 13). Bird management was consistent with the recommendations of Cobb Management Guide [3]. The chicks received the designated treatment diets within 12 h of hatch. The dietary ingredients included corn, de-oiled soybean meal (SBM), meat and bone meal, de-oiled mustard cake, vegetable oil, lime stone powder, di-calcium phosphate, common salt, vitamin premix, trace minerals and other additives which are normally used in standard commercial broiler diets. The diets were categorized as pre-starter (d 1-14), starter (d 15-28) and finisher (d 29 till harvesting). The chemical composition of the diets is presented in Table 1. The chickens had *ad libitum* access to feed and drinking water.

Dietary treatments: The dietary treatments were 1) a basal diet composed of corn and de-oiled SBM (T0), 2) T0 + 1% formic acid (T1), 3) T0 + 1.5% formic acid (T2) and 4) T0 + 2 % formic acid (T3). The formic acid was added to the basal diet at the expense of corn. All diets were formulated on an iso-nitrogenous and iso-caloric basis.

Measurement of performance and carcass traits: The birds were monitored daily for signs of disease and mortality. Live weight (LW) of individual chickens was recorded at d 21 and d 42 and the data were pooled pen-wise. Daily feed consumption was recorded pen-wise and terminal feed conversion ratio (FCR), corrected to 2 kg LW, was calculated for each pen on the basis of cumulative (d 1-21 and d 1-42) feed consumption. Mortality, if any, was recorded and liveability of the experimental flock was calculated for each experimental group.

On d 42, 4 birds (2 males and 2 females) having LW close to the mean LW from each pen were selected for determination of carcass traits. The chickens were mechanically stunted followed by exsanguination. The carcass was defeathered and eviscerated. The dressed carcass weight was determined after complete removal the organs and gastrointestinal tract (GIT). The giblet (heart, liver and gizzard) and spleen were severed out, washed with phosphate buffered saline and weighed. The abdominal fat was removed carefully with the help of a scalpel and weighed accurately. The breast muscle was separated and weighed.

The Economic return score (ERS) was calculated by the following formula:

$$ERS = \frac{\text{Percentage of liveability} \times \text{average final live weight(kg)}}{\text{Age of experimental birds} \times \text{FCR} \times \text{cost of feed(Rs/kg)}} \times 100$$

Chemical analyses: Feed samples were analyzed for dry matter, crude protein (N x 6.25) crude fibre and ether extract [4]. Metabolizable energy (ME) was calculated from standard tables of raw materials [5]. Calcium and available phosphorus content of the experimental diets were estimated by methods described as per IS: 7874 [6] and IS: 1374 [7], respectively.

Statistical analyses: All data were pooled replicate wise for analyses. Data were then analyzed statistically by complete randomize design and the mean difference was compared by Tukey's multiple range test [8]. Probability value of $P < 0.05$ was described as statistically significant and a probability of $P < 0.1$ was described as trend.

Table-1. Chemical composition of the basal diets (g/kg unless stated otherwise).

	Pre starter (d 1-14)	Starter (d 15-28)	Finisher (d 29-42)
Dry matter	905	904	912
Energy kcal/kg*	3000	3100	3140
Crude protein	222	203	185
Ether extract	36	44	53
Crude fibre	44	43	41

Salt	4.1	3.9	3.8
Calcium	9.1	8.6	8.6
Available P	5.0	4.8	4.6

*Calculated values

RESULTS AND DISCUSSION

The performance and carcass traits of the experimental broilers fed with incremental levels of formic acid are presented in Tables 2 and 3, respectively. Live weight gain (LWG) and FCR improved almost linearly with the dose level of formic acid during the starter and finisher periods. Supplementation of formic acid irrespective of the inclusion level improved LWG ($P<0.05$) at d 21 and d 42 as compared with the T0 group. Increasing the concentration of formic acid up to 1.5% in diet improved LWG and FCR and at 2% level of inclusion the FCR was numerically superior to that observed at 1.5% level. Analogous trend was observed for ERS too, which is consistent with the superior LWG and FCR in the formic acid supplemented groups. There are several reports on the effect of dietary acidification with formic acid on the performance of broilers. Improved growth performances due to formic acid treatment were reported earlier [9, 10]. Panda [2] reported a significant improvement in body weight gain and feed efficiency in broilers supplemented with 0.6% and 0.8% of formic acid as compared with broilers treated with varying level of antibiotics. However, the present study suggested that dietary supplementation of formic acid improved performance of the broilers probably by a reduction in the microbial competition with the host which enhanced nutrient digestibility [2, 11], minimized subclinical infections and boosted the immune response [9]. Mohhamad [12] reported a significant reduction in the *Salmonella gallinarum* counts in digesta and reduced pH of digestive tracts of the birds supplemented with 1.5% formic acid. However Hernández [13] observed no discernible positive effect on production performance of the broilers supplemented with formic acid at 5000ppm and 10000ppm levels. Overall mortality in the experimental stocks was below 1% and was not affected by dietary treatments.

Yield of dressed carcass increased ($P<0.05$) as the formic acid concentration in diet was increased. Lower abdominal fat content was reported in the birds supplemented with 1.5% and 2% formic acid in the diet, as compared with other treatment groups. These findings are in agreement with Panda [2], who reported significantly higher dressed yield and lower abdominal fat content in birds treated with 0.6%, 0.8% and 1% formic acid as compared to the antibiotic supplemented birds. Similar results were also obtained for butyric acid supplementation in broiler [14]. Formic acid supplementation in the diet of chicken results in reduced microbial deamination of amino acids [2, 15, 16]. This might be a probable explanation for better dressed weight and lower abdominal fat yield in the birds supplemented with 1.5% and 2% formic acid.

Table-2. Effects of supplementation of graded levels of formic acid on performance of experimental broilers

Experimental diets	Body weight gain (g)		Feed conversion ratio Corrected at 2 kg live weight		ERS
	1-21 d	1-42 d	1-21 d	1-42 d	1-42 d
T0	650^{c}	2215^{c}	1.49^{a}	1.88^{a}	13.63^{c}
T1	710^{b}	2355^{b}	1.41^{b}	1.81^{b}	14.04^{b}
T2	770^{a}	2425^{a}	1.36^{c}	1.77^{c}	14.57^{a}
T3	778^{a}	2395^{a}	1.37^{c}	1.75^{c}	14.88^{a}
SEM	5.15	8.30	0.03	0.05	0.94

Means bearing different superscripts in a column differ significantly ($P<0.05$)

ERS: Economic return score

T0: Basal diet containing corn-soybean meal; T1: T0+ 1% formic acid; T2: T0+ 1.5% formic acid; T3: T0+ 2% formic acid.

Table-3. Effects of supplementation of graded levels of formic acid on carcass traits of experimental broilers (measured at d 42 of age)

Experimental diets		Weight of carcass components (g/100g live weight)		
Dressed weight		Giblet	Abdominal fat	Breast muscle
T0	70.55^{b}	6.20	1.92^{a}	16.30
T1	70.70^{b}	5.95	1.88^{a}	16.25
T2	71.80^{a}	6.06	1.44^{b}	16.16
T3	72.10^{a}	5.99	1.42^{b}	16.24
SEM	0.30	0.18	0.06	0.21

Means bearing different superscripts in a column differ significantly ($P<0.05$)

T0: Basal diet containing corn-soybean meal; T1: T0+ 1% formic acid; T2: T0+ 1.5% formic acid; T3: T0+ 2% formic acid.

CONCLUSION

Findings of this experiment suggested that formic acid supplementation at a dose rate of 1.5% as well as 2% in the diet of broiler chickens is advantageous to obtain improved growth performance and carcass yield.

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