



Effect of Lauric acid on Broiler Chicken

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Effect of Dietary Supplementation of Lauric Acid on Performance and Carcass Characteristics in Commercial Broiler Chicken

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ABSTRACT

An experiment was conducted to evaluate the effect of dietary lauric acid (LA) supplementation as alternative to antibiotic growth promoter (AGP) at graded levels on performance and carcass traits in commercial broilers. Three-hundred-day-old commercial broiler chicks were randomly allotted to 6 dietary treatments with 10 replicates of 5 chicks in each. Corn soyabean meal based basal diet (BD) was formulated for pre-starter (1-2weeks), starter (3-4 weeks) and finisher (5-6 weeks) phases without antibiotic growth promoter (negative control). Positive control diet was the BD having 0.035% chlortetracycline as AGP. The remaining four experimental diets were formulated by supplementing lauric acid to BD at rate of 0.05% (LA-50), 0.075% (LA-75), 0.1% (LA-100) and 0.2 % (LA-200), respectively. Body weights, feed intake and feed conversion ratio (FCR) were measured at weekly intervals. At the end of 6th week, one bird from each replicate was selected randomly for studying carcass characteristics. Overall body weight gain (BWG) was higher ($P<0.05$) in chicks fed LA supplemented diets compared to BD fed chicks. Highest BWG was obtained in chicks fed LA-50 diet than those fed on either AGP or BD and was comparable to those fed LA-75 diet. Higher ($P<0.05$) feed intake was recorded in birds fed diets supplemented with LA-75 diets followed by LA-50, AGP, LA-200 and LA-100 fed birds. The FCR during all the phases was significantly ($P<0.05$) improved in LA-50 compared to other dietary groups. The dressing percentage was higher ($P<0.05$) with LA-50 compared to AGP fed birds, while at higher levels of LA supplementation, the dressing percentage was either comparable or higher than AGP or BD fed birds. No difference regarding breast, liver and gizzard weight was observed with LA supplementation. The feed cost/kg gain did not vary among the dietary groups. Based on the results it could be concluded that, lauric acid can be a replacer of antibiotic growth promoter and lower dose of lauric acid (0.05%) used in the present study was sufficient in improving performance and dressing percentage in broilers.

KEYWORDS: Antibiotics growth promoter, Broiler chicken, Carcass characteristics, Growth performance, Lauric acid

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INTRODUCTION

Profitability of broiler production depends on the growth rate, improved FCR and good gut health. During the last 50 years, use of antibiotic growth promoters (AGP) at sub-therapeutic dose has been widely practiced in poultry industry to stabilize the balance of gut ecosystem by elimination of intestinal bacteria in the gut and thereby improving the growth performance of chicken (Huyghebaert et al., 2011). But, the prolonged and unregulated use of AGPs has contributed in part to the development of antibiotic-resistant pathogen in poultry as well as in humans which enforced the European Union to ban use of

antibiotics as growth promoters in poultry diet since 1st January 2006 (Castanon, 2007). As a consequence, the poultry industry has needed to find alternatives to AGPs in order to stem the spike in infection rates, which are also environmental friendly and safe for both animal and humans consuming animal products (Cabuk et al., 2006). Among all, use of short chain fatty acids (SFCA) such as formic (C_1), acetic (C_2), propionic (C_3), and butyric acid (C_4), and few carboxylic acids such as lactic, malic, tartaric, fumaric, and citric acid are being mostly used in poultry diets (Dibner and Buttin, 2002). Recently medium chain fatty acids (MCFAs) (C_6 - C_{12}) were found to be more bactericidal to numerous gram-

negative and gram-positive bacteria than the SCFAs (Hermans et al., 2010). Most of the research conducted in poultry was by using SCFAs and some on caproic acid (C6), caprylic acid (C8) and capric acid (C10) as alternative to AGPs (Skøivanova et al., 2006; Begum et al., 2015). Lauric acid (C12) has broad spectrum activity and causes membrane lysis by increasing cellular permeability (Hemalatha et al., 2023; Ameena et al., 2024). Very less information is available on lauric acid, a medium chain fatty acid as an alternative to AGPs in poultry. Therefore, a study was undertaken to assess the effect of dietary supplementation of lauric acid as growth promoter on performance and carcass characteristics in commercial broilers.

MATERIALS AND METHODS

Three hundred, day-old commercial broiler chicks (Cobb-400) were randomly allotted to 6 dietary

treatments with 10 replicates of 5 chicks in each. All replicates were separately housed by positioning at random in identical-sized four-floor electrically heated battery cages having raised wire floors and fitted with feeder, water and a droppings tray underneath. The chicks of all groups were kept under uniform management and standard hygienic conditions throughout the experimental period. Birds were immunized for Newcastle disease on 7th and 28th d of age with Lasota vaccine and for infectious bursal disease on 14th and 21st day of age with Georgia strain vaccine. All replicate groups of chicks were offered the respective diets *ad libitum*. Clean and fresh drinking water was provided *ad libitum* daily. A corn-soybean meal based basal diet (BD) was prepared for pre-starter (1-14d), starter (15-28d) and finisher (29-42d) phases without antibiotic growth promoter (Negative control) (Table 1).

Table 1. Ingredient and nutrient composition of basal diets fed to broilers

Ingredient (g/kg)	Pre-Starter (1 to 14 days)	Starter (15 to 28 days)	Finisher (29 to 42 days)
Maize	539.86	561.51	606.05
Soyabean meal	382.65	345.71	294.66
Rice bran oil	34.86	49.46	59.23
Salt	4.24	4.24	4.23
Dicalcium phosphate	17.47	17.97	15.65
Lime stone powder	12.19	12.18	11.73
DL-Methionine	2.77	2.74	2.34
L-Lysine HCl	1.73	1.61	1.29
L-Threonine	0.12	0.46	0.67
L-Tryptophan	0	0.02	0.06
Nutrient composition (calculated)			
Metabolisable energy (kcal/ kg)	3000	3100	3200
Crude protein (%)	22.5	21.0	19.0
Calcium (%)	0.90	0.90	0.82
Non-phytate phosphorus (%)	0.45	0.45	0.40
Dig. Lysine (%)	1.25	1.15	1.00
Dig. Methionine (%)	0.57	0.55	0.49
Dig. Threonine (%)	0.77	0.75	0.70
Dig. Tryptophan (%)	0.225	0.210	0.19
Sodium (%)	0.18	0.18	0.18
Estimated composition			
Dry matter (%)	90.36	90.43	91.11
Crude protein (%)	22.65	21.02	19.06
Ether extract (%)	4.12	5.31	6.63
Crude fibre (%)	3.85	3.71	3.49

Positive control diet was prepared by supplementing chlortetracycline (0.035% in diet) as AGP to the BD. Remaining four experimental diets were formulated by supplementing lauric acid in powder form (procured from M/S AI Nutritions Pvt Ltd, Malaysia, Rs. 300/kg) to BD at rate of 0.05% (LA-50), 0.075% (LA-75), 0.1 % (LA-100) and 0.2 % (LA-200), respectively. During the experiment, body weights, feed intake and feed conversion ratio (FCR) were measured at weekly intervals. On 43rd day, one bird from each replicate was selected randomly, sacrificed by cervical dislocation after overnight fasting for studying carcass characteristics (weight of total carcass, weight of the breast, gizzard, bursa, spleen and abdominal fat). The results obtained were subjected to analysis through software (version 16.0; SPSS, 2007) by applying one way analysis of variance through generalized linear model and the treatment means were ranked using Duncan's multiple range test (Duncan, 1955) with a test of significance at 5%. All the statistical

procedures were done as per the procedures of Snedecor and Cochran (1980).

RESULT AND DISCUSSION

Performance

Higher ($P < 0.01$) BWG was observed in LA- 50 fed birds during all phases compared to AGP and BD groups (Table 2). The BWG during pre-starter phase and overall period was higher in AGP than BD fed birds. The BWG in birds fed LA-75 diet was comparable to LA-50 during all phases. At higher levels of supplementation of LA (LA-100 and LA-200), the BWG was lower than LA-50, but was comparable to AGP fed birds. Differences with regard to BWG, observed in pre-starter, starter and finisher phases were reflected in overall (0-6 week) BWG in chicks. The broilers fed LA-50 diet grew with highest BWG, followed by LA-75, lowest in BD fed birds and in other groups it was intermediate.

Table 2 Effect of dietary supplementation of lauric acid on body weight gain (g) in broilers during various phases

Diet	Pre-starter (0 to 2 weeks)	Starter (3 to 4 weeks)	Finisher (5 to 6 weeks)	Over all (0-6 weeks)
Basal diet (BD)	346.62 ^c	822.50 ^d	679.85 ^b	1849.0 ^d
AGP	358.68 ^b	848.00 ^{cd}	777.63 ^{ab}	1984.3 ^{bc}
LA-50	374.52 ^a	938.04 ^a	838.32 ^a	2150.9 ^a
LA-75	364.34 ^{ab}	919.64 ^{ab}	826.55 ^a	2110.5 ^{ab}
LA-100	366.28 ^{ab}	850.64 ^{cd}	677.89 ^b	1894.8 ^{cd}
LA-200	369.90 ^{ab}	875.14 ^{bc}	761.55 ^{ab}	2006.6 ^{bc}
N	10	10	10	10
SEM	2.008	8.304	17.002	22.132
P-value	0.001	0.001	0.012	0.001

^{abcd}Means with different superscript in a column differ significantly : $P < 0.05$, $P < 0.01$,

The overall higher BWG in LA-50 and comparable BWG in other LA (LA-75, LA-100 and LA-200) groups compared to AGP, could be attributed to antimicrobial activity of LA, exhibited by crossing the bacterial cell membranes in their un-

dissociated form and reduce the pH inside the bacterial cell causing the cell lysis (Dierick et al. 2002). Antimicrobial activity of LA lowers the load of pathogenic bacteria leading to the reduced metabolic needs of nutrients, thereby increasing the

availability of nutrients for growth. Reduced bacterial load in gut eventually decreases the concentrations of toxic metabolites from the bacteria, reduces bacterial fermentation of essential nutrients like protein and energy. The lower BWG in LA-100 and LA-200 fed groups compared to LA-50 could be due to lower feed intake (Table 3).

Further, these observations were in line with Jadhav et al (2021) in broilers fed diets containing 0.25% LA in comparison to control and AGP fed birds and that of Lipinski et al. (2016) in turkey poults with addition of MCFAs. Del Alamo et al. (2007) observed that inclusion of the MCFA blends (C6-C12) @ 0.20% in the starter (0-7days), 0.15% grower (8-21d) and 0.10% finisher (22-42 d) diets improved the BWG compared to the control group. Another study reported improvement in BWG with supplementation of medium chain fatty acids mixture consisting of 60% caproic acid, caprylic acid, capric acid and lauric acid (Khosravinia, 2015). Issac et al. (2013) reported that supplementation of 0.8 to 1.7 g/kg of MCFA resulted in to higher cumulative gain in weight in starter and grower phase. Similar to the present findings, Mathis et al. (2005) reported significant improvement in weight gain in broilers fed a product containing blend of organic acids (formic, acetic, propionic, sorbic acid) and medium-chain fatty acids (caprylic, capric acid) @ 0.1, 0.2 and 0.5% of diet.

The feed intake was lower in BD fed chicks during all phases (Table 3). The AGP fed chicks had higher ($P<0.01$) feed intake than BD birds, except during starter phase. The supplementation of LA at 0.05 to 0.2% of diet improved the feed intake during pre-starter phase, while during other phases and for the overall period, the feed intake was higher in LA-50 and LA-75 fed birds. While supplementation of LA at higher level (LA-100 and LA-200) resulted in lower ($P<0.01$) feed intake compared to lower supplementary levels of LA but comparable to AGP and BD fed birds.

Higher feed intake in LA supplemented groups could be related to fact that, LA being a MCFA influences the secretion of cholecystokinin and other intestinal hormones, that regulate the feed intake (Mabayo et al., 1992) and reduce the pH of gut that helps to increase pancreatic secretion which increases appetite and palatability of the feed (Cave, 1982). In the current study, the feed intake showed a trend of reduction with increase in dose (LA-100 and LA-200) of LA supplementation that could be attributed to its effect on ghrelin hormone produced by endocrine cells of the gastric mucosa controlling feed intake (Nakazato et al., 2001). Nishi et al. (2012) reported that ghrelin may get acylated by MCFA which changes its activity and reduces feed intake.

Table 3. Effect of dietary supplementation of lauric acid on feed intake (g/bird) in broilers during various phases

Diet	Pre-starter (0 to 2 weeks)	Starter (3 to 4 weeks)	Finisher (5 to 6 weeks)	Over all (0-6 weeks)
Basal diet (BD)	418.70 ^b	1256.10 ^b	1356.05 ^c	3030.9 ^d
AGP	430.88 ^a	1288.08 ^b	1528.9 ^{ab}	3247.9 ^{bc}
LA-50	442.80 ^a	1378.84 ^a	1580.43 ^a	3402.1 ^{ab}
LA-75	437.88 ^a	1384.48 ^a	1617.55 ^a	3439.9 ^a
LA-100	432.70 ^a	1278.10 ^b	1369.05 ^{bc}	3079.8 ^{cd}
LA-200	435.74 ^a	1310.74 ^b	1478.52 ^{abc}	3225.0 ^{bc}
N	10	10	10	10
SEM	1.856	10.270	25.162	30.719
P-value	0.003	0.001	0.004	0.001

^{abcd}Means with different superscript in a column differ significantly: $P<0.05$, $P<0.01$

Kessler et al. (2009) reported increased ($P < 0.05$) feed intake with replacement of 2.67% corn oil with coconut fat (oil rich in MCFA). Feed intake in broilers improved with dietary inclusion of 0.05% LA during starter, finisher and overall period in study by Pappula et al. (2021) corroborating with the present findings. Reduced feed intake observed in present study with higher doses of MCFA are in line with findings of Cave (1982) who observed depressed feed intake at higher supplementary levels of organic acids or MCFA (0.3% of either acetic, propionic, butyric, caproic, caprylic, capric or lauric acids) to basal diets. Zheng et al. (2006) also reported that supplementation capric acid at 0.08 % of diet reduced ($P < 0.05$) feed intake compared to those fed with 0.05% level.

Feed conversion ratio varied significantly ($p < 0.05$) during all phases and for overall period (1 to 6 week), except during finisher phase (Table 4). Higher BWG with feeding of LA-50 diet resulted in improved ($P < 0.05$) FCR compared to BD, AGP and other LA-fed birds during entire study corroborating with the findings of Hemalatha et al. (2023) when fed diets supplemented with 0.05% LA. In other groups, the

FCR was comparable. Nguyen et al. (2018) reported linear improvement in FCR with dietary supplementation of 0.05 and 0.06% blend of OAs and MCFAs levels in broilers. The improved FCR could also be due to reduced pathogenic bacteria load in the gut with MCFA supplementation. Reduction in coliform count might have minimized wastage of nutrients and also diverted them for body weight gain, which eventually resulted in improved feed efficiency in broilers fed MCFA. Addition of LA or other medium chain fatty acids at 0.1% to 0.4% in broiler diets had no effect on FCR (Shokrollahi et al., 2014; Khatibjoo et al., 2017; Jadhav et al., 2021, Demirci et al., 2023) and Japanese quails (Saeidi et al., 2016) corroborating with the present findings. De Los Santos et al. (2008) found no effect on FCR with dietary supplementation of caprylic acid (0.35, 0.525, 0.7, 0.875, 1.05, 1.225, or 1.4%) in broilers. Similarly, dietary supplementation of balance mixture of MCFA (caproic, caprylic and capric acid) (Shokrollahi et al., 2014), blends of MCFAs (C8-10), butyrate or combination of butyrate and MCFAs (Khatibjoo et al., 2017) showed no effect on FCR in broiler chicken.

Table 4. Effect of dietary supplementation of lauric acid on feed conversion ratio (g intake/g weight gain) in broilers during various phases

Diet	Pre-starter (0 to 2 weeks)	Starter (3 to 4 weeks)	Finisher (5 to 6 weeks)	Over all (0-6 weeks)
Basal diet (BD)	1.208 ^a	1.527 ^a	1.995	1.639 ^a
AGP	1.201 ^{ab}	1.519 ^a	1.966	1.637 ^a
LA-50	1.182 ^b	1.470 ^b	1.885	1.582 ^b
LA-75	1.202 ^{ab}	1.505 ^a	1.957	1.630 ^a
LA-100	1.181 ^b	1.503 ^a	2.020	1.625 ^a
LA-200	1.178 ^b	1.498 ^a	1.941	1.607 ^{ab}
N	10	10	10	10
SEM	0.0035	0.0042	0.0176	0.0058
P-value	0.042	0.001	0.369	0.037

^{ab}Means with different superscript in a column differ significantly : $P < 0.05$, $P < 0.01$, P- value: acid acid

Carcass characteristics

supplementation of LA @ 0.05% diet compared to AGP supplementation (Table 5).

The dressing percentage was higher with

Table 5. Effect of dietary supplementation of lauric acid on carcass characteristics of broiler chicken

Diet	Dressing %	Breast weight (% LW)	Liver weight (% LW)	Abdominal fat weight (% LW)	Gizzard weight (% LW)
Basal diet (BD)	70.97 ^{bc}	22.93	1.99	0.95	1.98
AGP	70.46 ^c	22.35	1.95	1.31	1.95
LA-50	72.59 ^{ab}	21.82	2.02	1.34	1.83
LA-75	71.58 ^{abc}	22.77	2.21	1.19	1.92
LA-100	72.64 ^{ab}	22.44	2.15	1.06	1.93
LA-200	73.20 ^a	21.82	2.12	1.06	1.81
SEM	0.261	2.157	0.048	0.049	0.028
N	10	10	10	10	10
P-value	0.010	0.427	0.611	0.164	0.455

^{abc} Means with different superscript in a column differ significantly: P<0.05, P<0.01,

While at higher supplementation of LA, the dressing percentage was either comparable or higher than AGP and BD fed groups. No difference was observed among various dietary groups with regard to liver, breast and gizzard weights and abdominal fat when expressed as percent of live weight. Similar to present findings, Papulla et al. (2021) observed no effect on carcass yield, abdominal fat, liver, gizzard and bursa weight was observed with supplementation of 0.05% LA in diets of broilers. At higher supplementary levels of LA (0.4%) the liver weight increased with no effect on dressing per cent,

gizzard and bursa weights in studies of Demirci et al. (2023). Addition of 0.1- 0.3% (Shokrollahi et al., 2014) or 0.1% (Khatibjoo et al., 2017) MCFA in diets did not affect carcass weights and weights of visceral organs in broilers.

Cost Economics

The feed cost per bird though differed among the dietary groups, being lowest on basal diet and highest when fed LA 50 diet, the feed cost per kg gain was not affected with dietary supplementation of lauric acid up to 0.2% (Table 6).

Table 6. Effect of dietary supplementation of lauric acid on cost economics of broiler chicken

Diet	Avg Cost of feed (Rs/kg)	Feed intake (g)	Total feed cost per bird (Rs)	Overall BWG (g)	Feed cost/kg weight gain (Rs)
Basal diet	36.12	3030.9 ^d	109.48 ^d	1849.0 ^d	59.3
AGP	36.23	3247.9 ^{bc}	117.66 ^{bc}	1984.3 ^{bc}	59.3
LA-50	36.26	3402.1 ^{ab}	123.36 ^{ab}	2150.9 ^a	57.4
LA-75	36.33	3439.9 ^a	124.98 ^a	2110.5 ^{ab}	59.3
LA-100	36.42	3079.8 ^{cd}	112.18 ^{cd}	1894.8 ^{cd}	59.3
LA-200	36.71	3225.0 ^{bc}	118.40 ^{bc}	2006.6 ^{bc}	59.1
N	10	10	10	10	10
SEM		30.719	1.11	22.132	0.22
P value		0.001	0.001	0.001	0.063

^{abc} Means with different superscript in a column differ significantly: P<0.05, P<0.01

CONCLUSION

The results of present study indicated that lauric acid (C12) supplementation in broiler diet at 0.05% without any antibiotic growth promoter resulted in higher growth and feed conversion ratio, while higher levels of supplementation (0.075 to 0.2%) of lauric acid had no further beneficial effects on performance of broilers.

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