



Performance of lemongrass (*Cymbopogon citrates*) oil as growth promoter in broiler

MR Tiwari¹, PK Jha*^{2,3}, B Sah¹, G Kunwar⁴ and AK Jha⁴

¹Animal Nutrition Division, Khumaltar, Lalitpur; ²Animal Breeding Division, Khumaltar, Lalitpur, Nepal; ³Department of Surgery and Obstetrics, Bangladesh Agricultural University, Bangladesh; ³Institute of Agriculture and Animal Science, Tribhuvan University, Kirtipur, Kathmandu; ⁴Regional Agricultural Research Station, Parwanipur, Bara, Nepal

Abstract

An attempt was taken to study the growth performance of lemongrass oil (*Cymbopogon citratus*) as a growth promoter on the broiler production. A total of 180 day-old broiler chicks were procured from private hatchery (Shivam Hatchery Birgung, Parsa, Nepal) and were allocated following Completely Randomized Design (CRD) into four treatment groups (each treatment with 3 replications and each replication with 15 birds); T₁= control, T₂= containing lemongrass oil 200 ml/100 kg feed, T₃= containing lemongrass oil 400 ml/100 kg feed and, T₄= containing lemongrass oil 600 ml/100 kg feed. The study was carried out for 36 days at Avian Research Unit, Regional Agriculture Research Station, Parwanipur, Bara, Nepal. Concentrate mixture and lemongrass oil were procured from Shakti Feed Industry, Birgung; Herbs Processing Plant of Ministry of Forest and Soil Conservation, Jadubuti, Kathmandu, respectively. Experimental birds were provided *ad libitum* amount of starter feed from 0 to 21 days and finisher feed from 22 to 36 days. Feed intake was recorded daily and body weight gain was measured in 7 days interval. The study revealed that the cumulative feed intake per bird was found higher in T₃ (3443.17g) followed by T₄ (3377.33g) and T₂ (3354.04g), respectively, and were statistically non-significant among the diet groups. The FCR was highest in T₃ (1:1.44 kg) and lowest in T₄ (1:1.51 kg), and differed insignificantly among the diet groups. Similarly, the total weight gain of the experimental bird was found to be higher in T₃ (2385.13g) followed by T₁ (2279.46g) and T₂ (2271.86g), respectively. The average daily gain of experimental birds noted higher in T₃ (66.25g) followed by T₁ and T₂ (63.31g) and (63.1g), respectively. The experiment suggested that inclusion of lemongrass oil could be considered as an alternative to antibiotic growth promoter in broiler diet to enhance the production performance.

Key words: broiler chicken, lemongrass oil, growth performance, Nepal

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Introduction

Livestock is an integral component of the mixed agricultural farming system in Nepal, contributing 29% of agriculture GDP (Gross Domestic Product), and about 11.5% of total national GDP (MoAD, 2072/73). The demand of increasing population shifting towards poultry farming for income generation and fulfill needs. In Nepal, the poultry farming is popular and at the apex comparing with other livestock commodities. The estimated total population of poultry in Nepal is about 68.63 million and producing 55041 metric ton meat per annum (Krishi Diary, 2017). Poultry meat as a diet is an important source of high-quality protein, minerals and vitamins for human health. The demand for poultry meat is high compared to sheep and goat meats.

To meet the increasing consumer's demand, Nepalese researcher is trying their efforts to increase safe, healthy and economic poultry production. On the other hand, they want to make sure this does not decrease the quality of the end product or ignore animal welfare. In particular, with the ban on the use of antibiotics to increase growth, studies on plant-based alternatives have emphasized. Performance enhancers until recently called growth promoters are used to improve animal growth rate and/or feed conversion ratio. One of the feed additives used to enhance the growth and found increasing performance in poultry is lemongrass (*Cymbopogon citratus*; Peter and Babu, 2012). Lemongrass is herb and proved to have health and medicinal benefits. This grass contains flavonoids, phenolic compounds, terpenoids (Lewis, 1986) and essential oils (such

*Corresponding author: drpankaj.np@gmail.com

as citral α , citral β , nerolgeraniol, citronellal, terpinolene, geranyl methylheptenone) which may be responsible for its different biological activities such as antibacterial, anti-diarrheal, antifungal, antioxidants, and as a growth promoter (Shah *et al.*, 2011). Several studies have been reported the use of lemongrass or its secondary metabolites for performance-enhancing purposes in poultry, especially in broilers (Mmereole, 2010; Mukhtar *et al.*, 2012; Thayalini *et al.*, 2011), pigs (Tartrakoon *et al.*, 2002) and rabbits (Omer *et al.*, 2010). Mmereole (2010) and Mukhtar *et al.* (2012) reported that lemongrass could be used as an alternative to antibiotics. The lemongrass metabolites as an oil (LGO) is considered as a viable alternative to antibiotics for the broiler and have been studied as an alternative for microbial and growth promoting abilities in the poultry, and that resulted minimized feed expense in the production chain. Several studies have been carried out on incorporating LGO in broiler diet as a supplement would stimulate the growth performance of broilers (Bampidis *et al.*, 2005; Cross *et al.*, 2007). Mukhtar *et al.* (2012) reported that broilers fed diets supplemented with different levels of LGO significantly consumed more feed and improved body weight gain compared to the control group. In Nepal, commercial poultry farmers are using antibiotics in the poultry diet as a growth promoter which is a hazard for human health. In this context, the inclusion of LGO in broiler diet is the most promising alternative of antibiotics. Therefore, this study was carried out with an aim to evaluate the effect of different levels of LGO oil in broiler diet for growth performance of commercial broilers.

Materials and Methods

The study was carried out during the period of December 2017 to January 2018 at Avian Research Unit, Regional Agricultural Research Station (RARS), Parwanipur, Bara, Nepal. The birds were procured from Shivam Hatchery, Birgung, Parsa, Nepal. The compound feed was procured from Shakti Feed Industry, Birgung, Parsa, Nepal. Lemongrass oil was procured from Herbs processing plant of ministry of forest and soil conservation, Jadibuti, Kathmandu. The proximate analysis of the feed samples both treated and untreated was estimated at Animal Nutrition Division, Khumaltar, Lalitpur, Nepal.

Proximate analysis

Respective samples were analyzed for dry matter (DM), organic matter (OM), total ash (TA), crude protein (CP) and crude fiber (CF) contents. The dry matter was determined by oven drying at 100°C for 24 hours. Crude protein was analyzed using the Kjeldahl method. Ash content was determined by ash at 550°C in a muffle furnace for 16 hours ((AOAC, 1980). The crude fiber of the samples was determined using the Van Soest method (Goering and Van Soest, 1970).

Birds management

The birds were kept in an opened house and raised on floor pens (0.90m²/bird) for 36 days. In the first week, all the birds had received vaccination against Ranikhet disease ('F1' strain; RDF) one drop/bird as recommended by world poultry science. Concentrate feed mixture was given on group basis and provided to the experimental birds once a day in the morning in ad lib amount for both periods (starter 0- 21 days and finisher 22-36 days). Clean drinking water was provided in adequate amount and water were made available at all times. The light was provided for 24 hours, natural light during the day and artificial light during night during the entire experimental period.

Experimental design

A total of 180 day-old broiler chicks were allocated into four treatment group; T₁= control, T₂= containing lemongrass oil 200 ml/100 kg concentrate mixture feed, T₃= containing lemongrass oil 400 ml/100 kg concentrate mixture feed, and T₄= containing lemongrass oil 600 ml/100 kg concentrate mixture feed. A Completely Randomized Design (CRD) was applied with three replication having 15 birds in each replication.

Observation and data recording

The trial period consisted for 36 days. The quantity of concentrate mixture given daily to the birds in group weighed daily and refusal was weighed in the next morning. The body weight gain measurement was done in a group basis (replication wise) in seven days interval in the morning before feed supply.

Data analysis

Data of feed intake and body weight gain was analyzed by one-way analysis of variance (ANOVA) by using computer statistical package SPSS version 16.

Results

Table 1: Chemical composition of the feeds (on DM basis %)

Treatment	DM	OM	TA	CP	CF	Gross energy, Kcal
Starter feed (1-21 days)						
1	89.31	94.68	5.32	18.07	5.53	
2	93.5	94.58	5.42	18.59	6.47	
3	89.19	97.31	2.69	18.12	7.16	
4	89.01	94.39	5.61	18.35	5.91	
Finisher feed (22-36 days)						
1	93.48	92.99	7.01	14.67	7.18	
2	92.95	94.35	5.65	14.14	5.44	
3	94.09	94.04	5.96	14.76	5.29	
4	93.6	93.63	6.37	14.41	7.43	
Lemongrass oil	NA	NA	NA	7.79	NA	8701.26

N. B. In poultry diet, lysine, methionine and tryptophan are essential element but due to unavailability of apparatus for above said element analysis it could not be performed.

Feed intake

Table 2 showed the average feed intake of experimental birds. It was observed that in the 7th days of the experiment, highest feed intake per bird was recorded in T₁ (40.8g) followed by T₃ (39.02g) and T₄ (38.22g), respectively, and varied significantly (P<0.05) among the diet groups. In 14th days of the experiment, feed intake per bird of T₁ (77.82g) and T₄ (77.37g), and T₂ (76.93g) and T₃ (77.3g) was almost similar and, were observed non-significant among diet groups. In 21st days of the experiment, highest feed intake per bird was noted in T₄ (128.48g) followed by T₁ (125.24g) and T₂ (124.53g), respectively, and were observed non-significant among the diet groups. Similarly, in

28th days of the experiment, highest feed intake per bird was observed in T₃ (168.39g) followed by T₂ (166.57g) and T₁ (165.46g), respectively, and were observed non-significant among diet groups. Likewise, in 36th days of the experiment, again highest feed intake per bird was found to be in T₃ (199.82g) followed by T₂ (187.33g) and T₄ (184.84g), respectively, however were observed non-significant among the diet groups. The cumulative feed intake per bird was found higher in T₃ (3443.17g) followed by T₄ (3377.33g) and T₂ (3354.04g), respectively, and were observed non-significant among the diet groups. The FCR was highest in T₃ (1:1.44 kg) and lowest in T₄ (1: 1.51 kg) which were also non-significant among diet groups.

Table 2: Feed intake of experimental birds (g; Mean ± SD)

Treatment	0 day	7 days	14 days	21 days	28 days	36 days	Cumulative feed intake	FCR
1	5.44±1.35	40.08±1.08	77.82±1.57	125.24±3.37	165.46±2.70	176.93±1.02	3330.95	1.46
2	4.30±0.33	36.08±0.65	76.93±2.20	124.53±4.10	166.57±3.24	187.33±1.09	3354.04	1.47
3	4.70±0.60	39.02±0.90	76.30±1.44	123.11±6.22	168.39±1.48	199.82±1.32	3443.17	1.44
4	5.19±0.70	38.22±1.98	77.37±1.42	128.48±2.43	161.90±7.06	184.84±1.93	3377.33	1.51
Mean	4.91±0.84	38.35±1.87	77.10±1.55	125.34±4.18	165.58±4.34	187.23±1.46	3376.37	1.47
P-Value	P>0.05	P<0.05	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05

Body weight gain

The average growth performance of experimental birds is given in Table 4. It was observed that highest body weight of bird in 7th day of the experiment was recorded in T₃ (182.22g) followed by T₁ (177.77g) and T₄ (175.55g), respectively. In 14th day of the experiment, again highest body weight was monitored in T₃ (486.66g) followed by T₄ (482.21g) and T₂ (479.99g), respectively. In 21st day of the experiment, higher body weight was found in T₁ (1033.00g) followed by T₃ (997.77g) and T₄ (986.66g), respectively. Similarly, in 28th day of the experiment, bird of T₄ weighed higher (1688g) than that of T₃ (1606.66g) and T₁

(1677.77g), respectively. Likewise, by the end of the experiment at 36th days, higher weight was found in the T₃ (2431g) followed by T₁ (2324g) and T₂(2316g), respectively. The inclusion of LOG did not affect significantly on body weight gain during experiment period from initial to end of the experiment (36 days). The trend of average body weight gained by the experimental birds is shown in Figure 1. The total weight gain of the experimental bird was found to be higher in T₃ (2385.13g) followed by T₁ (2279.46g) and T₂ (2271.86g), respectively. The average daily gain of experimental birds noted higher in T₃ (66.25g) followed by T₁ (63.31g) and T₂ (63.1g), respectively.

Table 3: Weight gain of experimental birds, (g; Mean ± SD)

Treatment	Initial weight	7 days	14 days	21 days	28 days	36 days	Total weight gain, g	ADG
1	44.97± 1.03	177.77± 10.18	471.1± 23.41	1033.0± 35.27	1677.77± 21.42	2324.0± 1.01	2279.46± 101.36	63.31± 2.81
2	43.64± 0.75	171.10± 3.85	479.99± 17.63	984.44± 36.71	1577.77± 86.75	2316.0± 0.35	2271.86± 82.61	63.10± 2.29
3	45.99± 1.96	182.22± 3.84	486.66± 24.03	997.77± 63.36	1606.66± 141.10	2431.0± 1.24	2385.13± 126.01	66.25± 3.50
4	44.22± 1.23	175.55± 3.85	482.21± 26.94	986.66± 80.82	1688.88± 16.77	2273.0± 6.67	2229.10± 7.10	61.85± 0.24
Mean	44.70± 1.45	176.66± 6.66	479.99± 20.69	1001.0± 52.98	1637.77± 86.70	2336.0± 98.20	2291.39± 97.99	62.62± 2.73
P- Value	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05	P>0.05

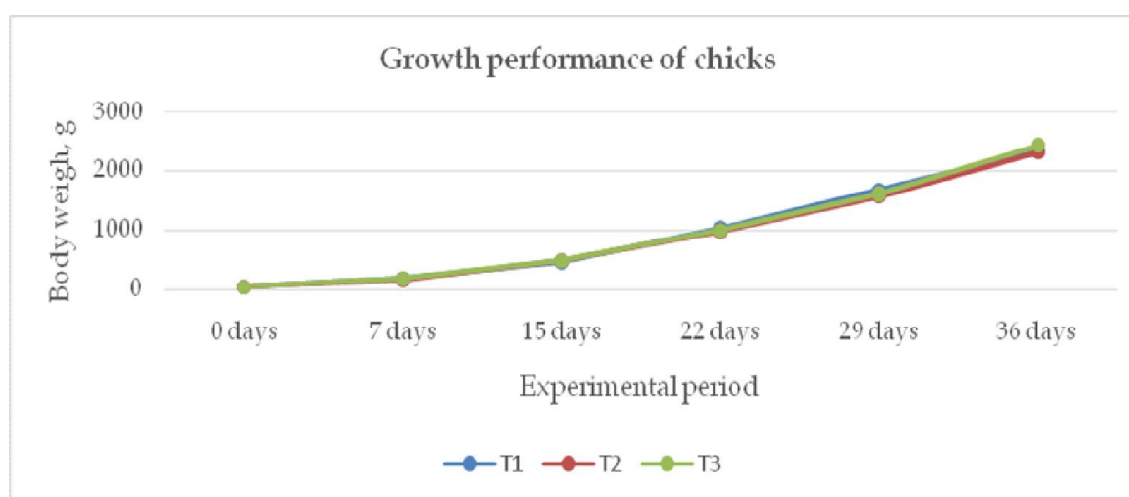


Figure 1: Trend of body weight gain fed experimental birds

Discussion

Our experiment showed that broilers fed diets treated with various levels of LGO consumed significantly more amount of feed 3442.17g, 3377.33g and 3354.04g for T₃, T₄ and T₂, respectively compared to the broilers fed control diet 3330.95g which was statistically non-significant. This positive effects of essential oil on feed consumption can be evaluated on the basis of different perspectives, firstly, the appropriateness of the extract levels for broilers and associated improvement in the feed taste, due to the essential oil as natural feed improving diet palatability, enhancing appetite of poultry, secondly the quicker passage and digestion of nutrients through the digestive effects of these natural products. These findings were in agreed with those of (Alcicek *et al.*, 2004). These results contradictory with the finding of Abaza *et al.* (2008) who found that addition of black cumin essential oil in the diet reduced significantly feed consumption of broilers. Similarly, the experiment revealed that the body weight gain was also higher 2385.13g in T₃ where LGO was included 400 ml/ 100 kg feed compared to the control group 2279.46g. This result was in the line of Tekeli (2011), where he noted that chicks fed on diet with supplemented LGO recorded significantly heavy weight gain, This improves may be attributed to the increase in total feed consumption, the active compounds, antimicrobial and antioxidant activities of the LGO. These results are in agreement with Tekeli (2011) and Mukhtar (2011) where their experiment revealed significantly improve in feed conversion ratio for broilers fed diets supplemented with various levels of LGO compared with the control group.

Several studies have been reported by the different researcher on the inclusion of lemongrass in broiler diet. Khattak *et al.* (2013) reported that the inclusion of lemongrass in the broiler diet improves the body weight gain with positive effects on feed conversion ratio. Cabuk *et al.* (2006) reported that the inclusion of lemongrass @ 24 mg/kg diet significantly improves the egg production, FCR and also reduction in the percentage of cracked eggs. Ozek (2011) reported that the use of lemongrass along with organic acid supplementation in commercial layers diet reduced the heat stress and also beneficial to increase the egg weight. Mukhtar *et al.* (2012) reported that 50, 100 and 150 ml/kg feed supplementation of lemongrass

oil in broiler diets increased feed consumption. An experiment conducted by Mmereole (2010) to evaluate the effects of dietary inclusion of lemongrass leaf meal (LGLM) on growth performances of broiler chickens and its ability to be utilized as a viable alternative to antibiotic growth promoters. The experiment involved two hundred and seventy day-old Abor-acre broiler chickens randomly separated into 3 experimental diet groups, with each being replicated 3 times. Ninety day-old birds were randomly allocated to each group and thirty birds per replicate. The diet groups were: Diet 1 (D₁ = control = basal diet), Diet 2 (D₂ = basal diet +1% LGLM) and Diet 3 (D₃ = basal diet+1% Teramycin antibiotic growth promoter). The results obtained indicated that the performances of the birds placed on control diet D₁ were significantly (P<0.05) lower in all parameters than those placed on D₂ and D₃. The results further indicated that, although the final body weight of the birds on D₂ (1895.56 g) was quantitatively higher than that of the birds in D₃ (1875.92 g), the difference was not significant (P>0.05). With respect to feed intake and feed conversion ratio, it was observed that there were no significant differences between the birds in D₂ and D₃.

Sariozkan *et al.* (2016) conducted to determine the effects of supplementation of lemongrass leaf meal on performance, carcass quality traits, and marketing of quail. A total of 150, four-day-old quail were distributed into three groups with five replicates and 10 quail each. Quail were fed either basal diet (control group) or 1.5% and 3% lemongrass leaf meal supplemented to basal diets for 5 weeks period. Lemongrass supplementation ratio did not affect significantly on live weight gain (P>0.05) at 1.5% level, however, 3% supplementation decreased live weight (P<0.05). Feed consumption and feed conversion ratio were not affected by lemongrass supplementation.

Mukhtar *et al.* (2012) conducted an experiment on broiler chicks for 42 days formulating five experimental diets (A, B, C, D and E). Diet A was control, diet B was supplemented with antibiotic (Neomycin 16 mg/kg) while diets C, D and E were supplemented with (LGO) at 50,100 and 150 mg/kg, respectively. Result obtained showed that addition of LGO significantly improved (P<0.05) body weight gain, feed intake and feed conversion ratio of broiler chicks as compared to the control group while non-significant (P>0.05) differences were noted among broilers fed on diets supplemented with

LGO and antibiotic supplemented groups, respectively. Results revealed non-significant differences ($P>0.05$) among all treatment groups regarding carcass dressing percentages gible, commercial cuts (breast, drumstick and thigh) and percentage of their separable tissue, meat chemical composition and subjective meat quality parameters. Economically the addition of LGO improved the performance of broiler chicks and resulted in economic benefits. Moreover, this study showed that LGO, when added as the growth promoter in broiler diets, had a similar effect like that with an antibiotic without any adverse effects. Tiwari *et al.* (2017) conducted an experiment on broiler chicken and reported that inclusion of LGO improved the weight gain, reduce mortality and can reduce the period of broiler harvesting.

Conclusion

This experiment revealed that the inclusion of lemon grass oil in broiler diet could be considered as an alternative to antibiotic growth promoter in broiler to enhance the production performance of broiler chicken.

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