Acta Veterinaria Brasilica June 11 (2017) 93-97

Acta Veterinaria Brasilica

Journal homepage: http://periodicos.ufersa.edu.br/revistas/index.php/acta

Original Article

# Lemon grass essential oil on productive characteristics of broiler chickens

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A R T I C L E I N F O

*Article history*
Received 29 September 2016
Received in revised form 18 May 2017
Accepted 23 May 2017

*Keywords:*
Poultry industry
Antimicrobial
*Cymbopogon citratus*
Performance

A B S T R A C T

The objective of this work was to evaluate the effect of lemon grass essential oil on the performance and yield of organs and commercial cuts of broiler chickens. Seventy-two one-day-old broiler chicks of the lineage Cobb 500 were evaluated for 42 days. A completely randomized experimental design was used, with three treatments of six broiler chicks and four replications. The treatments consisted of negative control diet (NCD), composed of basal feed, without antimicrobial; positive control diet (PCD), composed of basal feed with antimicrobial (zinc bacitracin) and anticoccidial; and lemon grass diet (LGD), composed of NCD with lemon grass essential oil. The performance of the broilers was lower with the use of lemon grass oil, compared with those in the treatment PCD. The broiler chickens in the treatment LGD had the lowest gizzard and drumstick weights and their commercial cuts were negatively affected by this treatment. Therefore, the use of lemon grass essential oil in the chicken broiler diet negatively affects their productive characteristics.

## INTRODUCTION

Poultry farming has expressive productive indexes, exceeding the expectations of world production. Moreover, this sector is responsible for generating millions of jobs, directly and indirectly (ABPA, 2015).

The Brazilian market competitiveness is due to the combination of technological innovations in input supply, distribution and logistics, with many researches in genetics, nutrition, health and management (ESPÍNDOLA, 2012; SANTANA et al., 2011; TINÔCO, 2001). However, adaptation to the international market is demanding in quality and requires great effort from the professionals involved with the poultry production chain (MAIA; DINIZ, 2009).

The use of antimicrobial growth promoters in poultry farming to improve zootechnical performance and feed efficiency of poultry is common (CARLOS, 2012; RIZZO, 2008). However, the use of these antimicrobials has raised concerns about the emergence of resistant microorganisms (KOIYAMA et al., 2014), and its residues on meat and eggs; and thus, their use were restricted for food safety (ESPÍNDOLA, 2012; SILVA et al., 2010).

Therefore, the use of essential oils of herbal plants in poultry diets is an alternative for this sector to adapt to the new market requirements. These essential oils are substances from the secondary metabolism of plants, and leave low residue content in poultry tissues, since these oils are quickly absorbed by the intestine and metabolized by their organisms (KOHLERT et al., 2000; ROYER et al., 2013).

The mechanism of action of the lemon grass (*Cymbopogon citratus*) essential oil is not fully explained in the literature, however, studies report its antimicrobial and antioxidant effects as related to improved digestion and nutrient absorption (SILVA et

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http://dx.doi.org/10.21708/avb.2017.11.2.6511

al., 2011).

The objective of this work was to evaluate the effect of lemon grass essential oil on the performance and yield of organs and commercial cuts of broiler chickens.

## MATERIAL AND METHODS

The present work was conducted in accordance with the Ethical Guidelines for Animal Experimentation and was approved according to the protocol 102/2013.

Seventy-two one-day-old broiler chicks from the lineage Cobb 500 (Cobb®) with average weight of 45.0±5 g were raised in cages (60 x 35 x 100 cm) arranged in a shed of concrete floor, clay tile roof, with curtains and fans. The environmental conditions were monitored daily by a data-logger (LogTag Humidity & Temperature Recorder®) in the center of the shed, at the mid-height of the animals. Water and feed were supplied ad libitum. Light, relative humidity and temperature were maintained as recommended by the manual of the lineage.

A completely randomized experimental design was used, with three treatments of six broiler chicks and four replications. The treatments consisted of negative control diet (NCD), composed of basal feed, without antimicrobial; positive control diet (PCD), composed of basal feed with antimicrobial (zinc bacitracin) and anticoccidial; and lemon grass diet (LGD), composed of NCD with lemon grass essential oil (80 mg $kg^{-1}$ of live weight). The nutritional plan was divided into four phases: pre-initial, initial, growth and final stages. The base feed used consisted of ground corn, and soybean bran, following the nutritional requirements recommended by Rostagno et al. (2011). The lemon grass essential oil was extracted by steam distillation (MING et al., 1996) and added during the feed processing. The rate used in the feed was previously established in laboratory through tests of minimal bacterial concentration (SOUZA et al., 2015). The feeds were stored into labeled black bags and lidded buckets to avoid effects of the environment in the oil.

The broilers and the feeds were weighed weekly during the the 42 days to evaluate the performance characteristics weight gain (WG), feed intake (FI) and feed conversion (FC = FI/WG). The total feed intake and feed conversion data were established from the dead chicken data (SAKOMURA; ROSTAGNO, 2007).

Two 42-day-old chickens (±10% of the average weight of the plot of each replication) were selected and fasted for 6 h to evaluate the carcass yield, commercial cut (chest, drumstick, thigh and wing) yields, absolute and relative weights of organs (intestine, liver, pancreas, gizzard, bursa, spleen and heart) and intestine length. The carcass yield was determined by the warm carcass weight (eviscerated) to live fasted weight ratio of the chickens. The other yields were determined by the part weight to warm carcass ratio.

*Statistical analysis*

Data were subjected to analysis of variance and significant means were compared by the Tukey's test at 5% of probability. Statistical procedures were performed using the package R (R Development Core Team, 2015).

## RESULTS AND DISCUSSIONS

The treatments affected ($p < 0.05$) the performance of the broiler chickens evaluated (Table 1).

Table 1. Average feed intake (g), weight gain (g), and feed conversion (g $g^{-1}$) of broiler chickens fed with and without lemon grass (*Cymbopogon citratus*) essential oil.

| Variable | Feed intake (g) | Weight gain (g) | Feed conversion (g $g^{-1}$) |
|---|---|---|---|
| Pre-initial stage (1 to 7 days of age) | | | |
| Negative control diet | 94.67 b | 43.92 b | 2.17 b |
| Lemon grass diet | 123.67 a | 43.67 b | 2.85 a |
| Positive control diet | 129.0 a | 88.50 a | 1.48 c |
| CV (%) | 8.58 | 10.11 | 15.16 |
| Initial stage (1 to 21 days of age) | | | |
| Negative control diet | 740.04 b | 371.50 b | 1.99 a |
| Lemon grass diet | 806.51 a | 373.02 b | 2.07 a |
| Positive control diet | 815.71 a | 527.50 a | 1.55 b |
| CV (%) | 1.58 | 6.58 | 5.30 |
| Final stage (1 to 42 days of age) | | | |
| Negative control diet | 3563.00 b | 1472.90 b | 2.48 a |
| Lemon grass diet | 3657.80 b | 1420.10 b | 2.58 a |
| Positive control diet | 4015.90 a | 1653.50 a | 2.44 a |
| CV (%) | 2.87 | 4.61 | 4.36 |

Means followed by different letters in the same column differed by Tukey's test ($p < 0.05$). Negative control diet = basal feed, without antimicrobial; Lemon grass diet = Negative control diet with lemon grass essential oil (80 mg $kg^{-1}$ of live weight); Positive control diet = commercial feed with antimicrobial (zinc bacitracin) and anticoccidial.

The feed intake in the treatments LGD and PCD was similar in the pre-initial development stage of the broiler chickens up to the end of the initial phase (21 days). Considering the whole period (42 days), chickens in the treatment PCD (with commercial antimicrobial) consumed more feed and had greater weight gain, compared with LGD and NCD. This low performance of chickens in LGD may be partly due to the use of oil without microencapsulation, resulting in the lowest feed conversion in the pre-initial stage. The supply of feed with oil in the development and growth stages of the chickens' gastro intestinal tract affected their digestive processes. Thus, the use of essential oils, singly or in combination with other oils, shows different results, as reported by Fukayama et al. (2005), Toledo et al. (2007) and Barreto et al. (2008). However, according to Azevedo et al. (2016), the use of microencapsulated essential oils (lemon grass, *Lippia alba* and these oils combined) showed potential use as additive in diet of broilers.

The feed conversion of the LGD treatment in the pre-initial stage was lower ($p < 0.05$) than those in of the PCD and NCD, and lower than that of the PCD in the initial stage (Table 1). Considering the total period, the feed conversion of chickens in the LGD was also lower, despite the non-statistical differences. Miguel et al. (2009) and Muro et al. (2015) found no effects on the performance in initial stages, using extract of turmeric, citrus, and grape seeds in the feed. According to Bertechini (2006), the raising condition affects the antimicrobial activity of the essential oil, however, the raising conditions in the present work (cages) may have prevented a significant antimicrobial activity of the oil. Koiyama et al. (2014) reported an improve in feed conversion of chickens in the growth stage (22 to 35 days of age) with the use of a combination of essential oils in their feed.

Chickens in the treatment LGD had the lowest ($p < 0.05$) weight of gizzards (Table 2), with decrease of 9.04 g compared with the treatment PCD. This result was expected due to the action of antibiotics in the treatment PCD, which results in greater weight gain, since beneficial bacteria of the gastrointestinal tract were favored (FASCINA, 2011; MENTEN et al., 2014). Texeira et al. (2011) reported effects on gizzard weight with different concentrations of *Pimpinella anisum* essential oil in the diet of chickens raised in new and recycled bedding.

Table 2. Absolute and relative weights of organs of broiler chickens, fed with and without lemon grass (*Cymbopogon citratus)* essential oil, at 42 days of age.

| Variable | Negative control diet | Lemon grass diet | Positive control diet | Coefficient of variation (%) | Pr>F |
|---|---|---|---|---|---|
| | | | Absolute weight (g) | | |
| Intestine | 91.34 a | 85.12 a | 87.13 a | 14.25 | 0.779 |
| Pancreas | 24.02 a | 21.00 a | 20.68 a | 16.55 | 0.386 |
| Liver | 32.13 a | 31.07 a | 35.17 a | 12.98 | 0.406 |
| Gizzard | 12.83 b | 11.36 b | 20.40 a | 16.48 | 0.0012 |
| Bursa | 1.54 a | 1.46 a | 1.88 a | 14.43 | 0.068 |
| Spleen | 6.71 a | 5.19 a | 5.82 a | 2.54 | 0.395 |
| Heart | 8.86 a | 9.41 a | 10.24 a | 21.34 | 0.641 |
| Intestine (cm) | 174.12 a | 173.62 a | 177.62 a | 6.55 | 0.868 |
| | | | Relative weight (%) | | |
| Intestine | 7.47 a | 7.44 a | 6.40 a | 13.72 | 0.261 |
| Pancreas | 1.97 a | 1.85 a | 1.51 a | 1.68 | 0.134 |
| Liver | 2.66 a | 2.70 a | 2.58 a | 14.51 | 0.905 |
| Gizzard | 1.04 ab | 1.00 b | 1.51 a | 20.35 | 0.029 |
| Bursa | 0.14 a | 0.13 a | 0.14 a | 16.87 | 0.654 |
| Spleen | 0.56 a | 0.46 a | 0.43 a | 31.91 | 0.497 |
| Heart | 0.74 a | 0.84 a | 0.75 a | 28.08 | 0.798 |

Means followed by different letters in the same row differ by the Tukey's test ($p < 0.05$). Negative control diet = basal feed, without antimicrobial; Lemon grass diet = Negative control diet with lemon grass essential oil (80 mg $kg^{-1}$ of live weight); Positive control diet = commercial feed with antimicrobial (zinc bacitracin) and anticoccidial. (n = 2 broilers per plot).

The treatments probably benefited the microorganisms colonizing the gizzard, which resulted in greater growth and activity of this organ, contributing to a greater feed efficiency. According to Boleli; Maiorka; Macari (2002), the gizzard is colonized predominantly by anaerobic bacteria and facultative anaerobic microorganisms, which establish in the gizzard, few days after hatching.

Table 3. Carcass and cut yields of broiler chickens fed with and without lemon grass (*Cymbopogon citratus)* essential oil, at 42 days of age.

| Variable | Negative control diet | Lemon grass diet | Positive control diet | Coefficient of variance (%) | Pr>F |
|---|---|---|---|---|---|
| Absolute weight of commercial cuts (g) | | | | | |
| Live weight | 1463.63 ab | 1353.25 b | 1611.75 a | 8.55 | 0.051 |
| Carcass | 1227.75 a | 1143.50 a | 1371.38 a | 9.32 | 0.059 |
| Chest | 295.38 a | 295,76 a | 315.71 a | 1.09 | 0.623 |
| Drumstick | 158.86 ab | 140.84 b | 190.15 a | 10.08 | 0.001 |
| Thigh | 175.20 ab | 161.32 b | 201.47 a | 11.00 | 0.049 |
| Wing | 120.67 ab | 115.19 b | 137.26 a | 7.36 | 0.019 |
| Relative weight of commercial cuts (%) | | | | | |
| Carcass | 83.81 a | 84.55 a | 85.06 a | 2.07 | 0.613 |
| Chest | 24.05 a | 25.93 a | 22.99 a | 6.14 | 0.060 |
| Drumstick | 12.99 ab | 12.31 b | 13.84 a | 5.14 | 0.030 |
| Thigh | 14.25 a | 14.11 a | 14.68 a | 4.60 | 0.478 |
| Wing | 9.85 a | 10.09 a | 10.02 a | 3.40 | 0.613 |
| Cuts | 51.28 a | 52.33 a | 51.51 a | 3.73 | 0.729 |

Means followed by different letters in the same row differ by the Tukey's test ($p < 0.05$). Negative control diet = basal feed, without antimicrobial; Lemon grass diet = Negative control diet with lemon grass essential oil (80 mg $kg^{-1}$ of live weight); Positive control diet = commercial feed with antimicrobial (zinc bacitracin) and anticoccidial. (n = 2 broilers per plot).

Broilers in the treatment LGD had lower ($p < 0.05$) commercial cut yields and absolute weight, compared with those in the PCD (Table 3). The lower cut yields may be related to the lower weight gain of broilers in the treatment LGD. Azevedo et al. (2017) found no significant differences in carcass and commercial cut yields, using singly or combined microencapsulated essential oils of lemon grass and *Lipia rotundifolia*. However, Teixera et al. (2011) and Koiyama et al. (2014) found greater commercial cut yields, using *Pimpinella anisum* essential oil, and a mixture of different oils.

## CONCLUSION

The use of lemon grass (*Cymbopogon citratus*) essential oil in the broiler chickens diet negatively affects their productive characteristics.

## ACKNOWLEDGEMENTS

The authors thank the Minas Gerais State Agency for Research and Development (FAPEMIG), the Brazilian National Council for Scientific and Technological Development (CNPq), the Coordination for the Improvement of Higher Education Personnel (CAPES) and the Pro Rectory of Research (PRPq) of the Federal University of Minas Gerais (UFMG).

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