ECOSISTEMAS Y RECURSOS AGROPECUARIOS

Mexican oregano (*Lippia berlandieri* Schauer) oil on turkey slaughter quality

Aceite de orégano mexicano (*Lippia berlandieri* Schauer) sobre la calidad en el sacrificio de pavos

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ABSTRACT. The quality of slaughtered turkeys fed a diet supplemented with Mexican oregano (*Lippia berlandieri* Schauer) oil was investigated. Two treatments were studied. T0: control diet and T1: control diet + 400 mg kg^{-1} of oregano oil with 60 % carvacrol. Live weight at slaughter was different, with T0 weighing 11.0 kg and T1 11.89 kg, while the performance of feathers and drumstick was higher in T0 (4.33 and 3.18 % respectively). Viscera, blood, head, neck and hot and cold carcass yield did not differ between treatments ($p > 0.05$). Oregano oil at 400 mg kg^{-1} can be used in the production of turkeys to influence slaughter quality.
Key words:live weight, carvacrol, yield, carcass.

RESUMEN. La inclusión de aceite de orégano mexicano (*Lippia berlandieri* Schauer) en dietas de pavos fue investigada sobre la calidad en el sacrificio de los pavos. Se evaluaron los tratamientos T0: dieta testigo y T1: dieta testigo + 400 mg kg^{-1} de aceite de orégano con 60 % de carvacrol. El peso vivo al sacrificio de los pavos fue diferente, T0 presentó 11.0 kg y T1 11.89 kg, mientras que el rendimiento de plumas y patas fue mayor en T0 (4.33%) que T1 (3.18 %). En tanto que en vísceras, sangre, cabeza, cuello, rendimiento de canal caliente y fría no se detectaron diferencias entre tratamientos. El aceite de orégano en 400 mg kg^{-1} puede ser usado en la producción de pavos para influir sobre la calidad en el sacrificio.
Palabras claves:peso vivo, carvacrol, rendimiento, canal.

INTRODUCTION

The turkey (*Meleagris gallopavo*) was among the first animals domesticated in Mexico (Canul *et al.* 2011), and its meat has been used as a source of protein, fat, sodium, iron and potassium (Laudadio *et al.* 2009). However, the market now requires meat free of microorganisms and antibiotics from the animal production system to the final product. The use of plant extracts are currently being investigated as an alternative to antibiotics in poultry production systems, so there is interest in the use of essential oils derived from herbs and spices such as oregano (Kirkpinar *et al.* 2014).

Oregano oil (OO) has antioxidant and antimicrobial properties, so it offers an important benefit in the livestock sector. In general, OO is composed of volatile substances such as carvacrol, thymol, β-myrcene, α-terpinene, γ-terpinene, p-cymene and cineole (Vazquez and Dunford 2005, Bakkali *et al.* 2008, Do *et al.* 2015). These characteristics give OO its antioxidant, antibacterial and medicinal ca-

pacity, and its usefulness as a treatment of gastrointestinal disorders (Rivero-Cruz *et al*. 2011). In particular, Mexican oregano (*Lippia berlandieri* Schauer) is a species characterized by a strong smell, biological activity and high yield of essential oils (Dunford and Vazquez 2005, Avila-Sosa *et al*. 2010). The main compounds of the genus *Lippia* are carvacrol, thymol, cymene, pinene and linalool; these components confer its antibacterial, antioxidant, antiviral, anti-fungal and insecticidal properties (Vazquez and Dunford 2005, Ortega-Nieblas *et al*. 2011).

The use of oregano oil in turkey fattening has been little researched. Studies conducted so far have highlighted that OO could be used in the production of turkeys and that they delay lipid oxidation in the breast (Bampidis *et al*. 2005, Botsoglou *et al*. 2010, Giannenas *et al*. 2014). Therefore, it would be interesting to provide more information on the influence of OO in turkey fattening. In this sense, although a few studies have been focused on assessing lipid oxidation in turkey breast and reducing the prevalence of pathogenic bacteria with OO of *Origanum vulgare* L., there is little information on the effect of Mexican oregano (*Lippia berlandieri* Schauer) oil on turkey meat performance. Therefore, the aim of this research was to evaluate the influence of Mexican oregano essential oil added to the diet on the slaughter quality of commercial turkeys.

MATERIALS AND METHODS

Research was conducted in the Faculty of Animal Science and Ecology at the Autonomous University of Chihuahua, Chihuahua, Mexico. Chihuahua City is located between 28° 05' and 29° 48' NL and 105° 41' and 106° 38' WL at an elevation of 1 440 masl; it has a dry temperate climate with an annual temperature range of 10-20 °C and rainfall of 200-600 mm (INEGI 2015). Turkey fattening was carried out in the Turkey Fattening Area and the slaughter process in the Faculty Meat Unit.

Two treatments were evaluated: T0 control diet (Table 1) and T1 the control diet + 400 mg kg^{-1} of OO (*Lippia berlandieri* Schauer) with 60 % carvacrol. The OO was acquired from the Natural Solutions company, located in Ciudad Juarez, Chihuahua. OO composition was analyzed on a PerkinElmer® Clarus 600 and SQ8 gas chromatograph. The oil was incorporated based on the weight of the diet, mixing it with the plant oil of the diets. Both treatments consisted of 700 day-old American *Orlopp* medium genetic line turkeys. Flock fattening lasted 18 weeks, which was carried out in different 240 m^2 pens with a concrete floor and sawdust chips, 18 feeders (6 kg diet $feeder^{-1}$) and 16 waterers (8 L $waterer^{-1}$). The diets used were prepared based on the pre-initiation, initiation, growth, termination 1 and termination 2 stages (Table 1; NRC 1994). Feed and water were provided ad *libitum* throughout the fattening period. At the end of fattening the slaughter was performed to evaluate the slaughter variables, for which a completely randomized sampling of 45 unsexed turkeys was conducted per treatment, considering each turkey as an experimental unit.

Turkey feeding was suspended 12 h before slaughter. The slaughter process was performed according to the method used by Al-Kassie (2009) and NOM-033-ZOO (1995). Turkeys were placed on slaughter hooks, previously desensitized with an electric shock of 120 V 50 Hz for 5 s, then killed with a cut in the neck to bleed them for 3 min. Subsequently, turkeys were scalded in water at 60 ± 1.0 °C for 90 s, and then plucked. The carcass was obtained by separating the head, drumsticks and viscera, which were then washed and placed in a cooling tub with water at 4.0 ± 1.0 °C for 20 min. After this, the carcasses were removed, drained for 15 min and then stored at 4 ± 1.0 °C for 24 h.

Live weight at slaughter (LWS), weight of blood, feathers, drumsticks, head, neck, viscera and hot carcass weight were evaluated at slaughter, and then the percentage values were determined according to LWS (Kirkpinar *et al*. 2011). Hot carcass yield (HCY) was calculated with LWS and hot carcass weight, while cold carcass weight was obtained at 24 h post mortem to determine cold carcass yield (CCY).

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Tabla 1. Formulation of the rations used.

Ingredients (%)[1]	Diet[2]				
	Pre-initiation Week 0-2	Initiation Week 3-5	Growth Week 6-9	Finalization 1 Week 10-13	Finalization 2 Week 14-17
Ground sorghum	40.9	43.9	51.6	60.0	68.2
Soybean meal	50.0	46.5	39.5	31.5	23.8
Dicalcium phosphate[3]	2.4	2.2	1.7	1.5	1.4
Calcium carbonate	1.2	1.5	1.5	1.5	1.2
Vegetable oil	3.0	4.0	3.8	3.6	3.5
Premix of vitamins and minerals[3]	2.5	2.0	2.0	2.0	2.0

[1]ingredients incorporated per kg of diet; [2]diets were formulated according to the nutritional requirements for turkeys suggested by NRC (1994); [3] purified B-glucans, DL-α Tocopherols, zinc proteinates, selenium, vitamin A-acetate, protected vitamin C, vitamin D_3 intermediate metabolites

The data of the measured variables were subjected to analysis of variance via the PROC GLM procedure (SAS 2002), based on the statistical model: $y_{ij} = \mu + T_i + e_{ij}$; where: y_{ij} = response variable for the effect of the i-th treatment; μ = overall mean; T_i = effect of the i-th treatment (T0 and T1); e_{ij} = the residual error normally distributed with zero mean and variance σ^2 [$\varepsilon_{ij} \sim N(O, \sigma^2)$]. Differences between treatments were determined at a significance level of 0.05.

RESULTS AND DISCUSSION

Chromatographic analysis of the oregano oil indicated that the composition was 60.02 % carvacrol, 3.96 % thymol, 23.63 % cineole, 9.57 % p-cymene, 0.11 % gamma-terpinene and 2.70 % other compounds. Essential oils have been recognized for their antimicrobial activity and influence on birds' productive performance (Lee *et al*. 2004). But few studies have evaluated the effect of OO on turkey characteristics at slaughter. In this study, the LWS of turkeys was different between treatments ($p < 0.05$), T1 being 890.0 g heavier than T0, which differs from Papageorgiou *et al*. (2003) and Bampidis *et al*. (2005), who found no effect on turkey live weight, in addition to indicating that the constituents of OO can stimulate feed intake and improve nutrient assimilation. In this regard, studies in chickens made with OO in the feed found improved chicken weight. This result can be attributed to the thymol and carvacrol, which stimulate digestibility and increase nutrient absorption (Symeon *et al*. 2009, Roofchaee *et al*. 2011, Alali *et al*. 2013, Küçükyilmaz *et al*. 2014, Méndez-Zamora *et al*. 2015). Therefore, the increase in turkey LWS could be due to the OO in T1.

The influence of essential oils depends on the concentrations used in the diet (Marcinčák *et al*. 2011), so some of their components may have an effect on the metabolism of the birds and weight of the organs (Simsek *et al*. 2007). In this study the blood, viscera, head and neck showed no statistical differences between treatments (Table 2), since possibly the effect of 400 mg kg^{-1} of oregano oil added to the diet had no effect on the evaluated variables. Similar results were reported in studies by Bampidis *et al*. (2005) and Küçükyilmaz *et al*. (2014), who found no statistical differences in turkey and chicken viscera, while studies in chickens suggested that essential oils can modify hemoglobin and cholesterol, but not bird slaughter variables (Toghyani *et al*. 2011, Issa and Abo 2012, Küçükyilmaz *et al*. 2014).

Few studies have reported the effect of OO on turkey slaughter variables. The weight of feathers and drumsticks was different between treatments ($p < 0.05$). This may be due to the weight of the turkeys, with T1 presenting the highest LWS values. This evidence indicates a possible effect of OO on some turkey slaughter variables.

Turkey carcass characteristics depend on the capacity for lean tissue deposition (Firman 2004). In the evaluated treatments no statistical differences in HCY and CCY were detected (Table 2). In this regard, Lee *et al*. (2004) indicate that some OO components in diets can be deposited in the flesh of the carcass through improved digestive efficiency,

Tabla 2. Influence of oregano oil incorporated into the diet on turkey slaughter quality.

Variables[1]	Treatments[2]		F	P value
	T0	T1		
LWS (kg)	11.00 ± 0.13	11.89 ± 0.13	22.52	<0.0001
Feathers (%)	4.33 ± 0.11	3.72 ± 0.11	16.04	0.0001
Drumsticks (%)	3.18 ± 0.04	2.91 ± 0.04	19.45	<0.0001
Blood (%)	3.69 ± 0.11	3.72 ± 0.11	0.03	0.8533
Viscera (%)	8.02 ± 0.17	8.25 ± 0.17	0.92	0.3408
Head (%)	1.76 ± 0.03	1.71 ± 0.03	1.54	0.2183
Neck (%)	5.37 ± 0.06	5.29 ± 0.06	0.84	0.3629
HCY (%)	73.65 ± 0.24	73.85 ± 0.24	0.36	0.5496
CCY (%)	76.56 ± 0.29	76.48 ± 0.29	0.03	0.8575

[1]LWS = Live weight at slaughter; HCY = Hot carcass yield; CCY = Cold carcass yield; [2] T0 = control diet; T1 = control diet + 400 mg kg-1 oregano oil (*Lippia berlandieri* Schauer; 60 % Carvacrol); Means (± Standard error) and F value in the same row are significantly different if $p < 0.05$ (n=45).

while research with chickens found no effect on carcass yield with 28.8 mg kg-1 of carvacrol and 300 mg kg^{-1} of OO (Küçükyilmaz *et al*. 2014, Kirkpinar *et al*. 2014). On the other hand, with 1600 mg kg^{-1} of oregano (*Lippia berlandieri* Schauer) oil an effect was found on hot and cold chicken carcass (Méndez-Zamora *et al*. 2015). With 400 mg kg^{-1} of oregano oil there was a response in turkey live weight at slaughter, without affecting hot and cold carcass yields. Therefore, further research should be carried out with higher levels of OO (*Lippia berlandieri* Schauer) and emphasis should be placed on studying meat quality variables such as nutrients, lipid oxidation, antimicrobial effect and preservation of food of animal origin.

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