Effect of Oregano and Tea Tree Essential Oils on Bioproductive Indices of Broiler Chickens

Călin Julean[1], Lavinia Ştef[1], Eliza Simiz[1], Adela Marcu[1*], Ioan Pet[1], Mărioara Nicula Neagu[1], Vasile Rus[1], Ducu Ştef[1]

[1]Banat University of Agricultural Sciences and Veterinary Medicine "King Michael I of Romania" from Timisoara, Timisoara - 300645, Calea Aradului, 119, Romania

Abstract

The purpose of this experiment was to determine the effect of oregano and melaleuca essential oils administered in a dose of 250 mg/kg CF in the feeding of broiler chickens on the bioproductive indices. The biological material was represented by sexed (male) broiler chickens belonging to the ROSS 308 hybrid on which the phasial breeding (1-10d, 11-24d, 25-35d) was practiced, while observing the recommendations from the ROSS 308 Broiler Management Guide, 2014. The chickens were divided into 3 experimental variants (T0, T1, T2), with 3 replications and 10 chickens/replication. The chickens from T0 (control) have received only the basic diet, for T1 the basic diet+oregano essential oil (250 mg/kg CF) were administered, and for T2, the basic diet+melaleuca essential oil (250 mg/kg CF). During the first breeding period (0-10d), the highest value for the body weight was recorded at T1 (267.66 g), which also had the lowest feed conversion ratio (1.20 kg CF/kg WG). In the period 11-24d, in T2, the highest body weight (1034.41 g) with the feed conversion ratio 1.52 kg CF/kg WG were recorded. In the finisher phase (25-35d), T1 maintained differences compared to T0, for body weight higher 2.91% and lower 6.25%, for FCR. During the entire breeding period 1-35d, the lowest FCR was recorded in T1 (1.65 kg CF/kg WG). The difference between experimental variants was not statistically for $p>0.05$.

Keywords: broiler, feed conversion ratio, oregano essential oil, phytobotanical additives, tea tree essential oil..

1. Introduction

The year 2006 brought new regulations regarding the use of antibiotics as growth promoters in the field of animal husbandry. Their ban has led to the need to test and use other additives to ensure the achievement of bioproductive performance and animal health. Thus, studies conducted in this field have considered possible alternatives: probiotics, prebiotics, plants and essential oils extracted from plants. Of these feed additives, the mode of action of plants and essential oils has not yet been fully elucidated. Some authors consider that these additives function as promoters of digestibility, stimulating the production of endogenous enzymes, [1, 2] while other authors have shown that there are plants and essential oils that can improve feed intake, feed conversion and weight gain [2, 3]. Other studies have shown that some phytoadditives have antimicrobial, antiviral and antioxidant properties [4-7].

In recent years, essential oils have attracted more and more attention, as they are natural, non-toxic and leave no residue in food.

Oregano essential oil is extracted from plants of the genus Origanum and contains up to 85% thymol and carvacrol [7, 8]. These components are associated with antifungal activities [9], antioxidant [10], digestibility promoters by stimulating the secretion of endogenous enzymes [2]. Regarding the action of oregano essential oil on productive performance, studies are quite controversial. Thus, some authors report positive

* Corresponding author: Adela Marcu
Tel: 0723235396, Email: adelamarcu@usab-tm.ro

effects on these characteristics [3, 11], other researchers lack these effects [12].

Melaleuca alternifolia essential oil, commonly called tea tree, is a mixture of substances with antimicrobial, antibacterial, immunomodulatory, antioxidant and digestive properties [12]. It has also been shown to possess acaricidal properties [13]. Regarding the productive performance of poultry, studies have shown that the inclusion of tea tree essential oil in concentrations of 50 to 150 mg/kg in broiler chickens diets has led to a significant increase in daily weight gain (approximately 7%) leading to and improved feed utilization compared to the control group [14]. Decreases in morbidity and mortality have also been observed [13].

Due to the properties demonstrated so far, the prospects for the use of these essential oils as additives in poultry diets are optimistic in terms of efficiency and production. By means of this study, the effect of oregano *(Origanum vulgare)* and tea tree *(Melaleuca alternifolia)* essential oils in a concentration of 250 mg/kg CF was followed on the nutritional and bioproductive indices of broiler chickens.

2. Materials and methods

The experiment performed to establish the effects of oregano *(Origanul vulgare)* and tea tree *(Melaleuca alternifolia)* essential oils in a concentration of 250 mg/kg CF on the nutritional and bioproductive indices of broiler chickens, was carried out during a five weeks period. The used biological material was represented by sexed broiler chickens belonging to the commercial broiler hybrid ROSS 308. 90 one day broiler chickens have been distributed into three experimental variants (T0-control group, T1, T2 experimental groups), each with three replications/variant and 10 chickens/replication (Table 1).

Table 1. Experimental design

1–10 d (Starter)		
T0 (n=30)	T1 (n=30)	T2 (n=30)
Basic diet	Basic diet+Oregano essential oil 250 mg/kg CF	Basic diet+Tea Tree essential oil 250 mg/kg CF
11-24 d (Grower)		
Basic diet	Basic diet+Oregano essential oil 250 mg/kg CF	Basic diet+Tea Tree essential oil 250 mg/kg CF
25-35 d (Finisher)		
Basic diet	Basic diet+Oregano essential oil 250 mg/kg CF	Basic diet+Tea Tree essential oil 250 mg/kg CF

The breeding period was 35d and the phasial growth was practiced: starter 0-10d, grower 11-24d and finisher 25-35d. The chickens were raised on the deep litter of straw bedding. *Ad libitum* feeding was used, with combined feed (CF). The CF have had nutritional specifications specific to every breeding phase: starter ME 3007 kcal/kg and 23.01% CP; grower ME 3099 kcal/kg and 21.50% CP; finisher ME 3196 kcal/kg and 19.99% CP (Table 2). The chickens received water *ad libitum*. The microclimate was according to recommendations from the ROSS 308 Broiler Management Guide of the Aviagen Company, 2014. The chickens from variant T0 (control group) were fed with the basic diet, for variant T1 the basic diet+oregano essential oil 250 mg/kg CF were administered, and for the experimental variant T2, the basic diet+tea tree essential oil, respectively 250 mg/kg CF, were administered. Oregano and tea tree essential oils have been incorporated in the CF on a sunflower oil support.

The chickens were weighted at 1, 10, 24 and 35 d. Knowing the values for the body weight at the beginning and end of every breeding period, the weight gain (WG) was calculated. Knowing the weight gain, the average daily gain (ADG/period) was calculated for every breeding period. The average daily gain represents the ratio between the total weight gain and the number of days from every breeding period.

Also, the administered CF quantities have been recorded daily, and at the end of each

experimental phase, the consumed CF quantity was calculated for every variant. By dividing this quantity to the number of chickens from every replication, the CF quantity consumed by every chicken was obtained.

Table 2. The combined feed recipes

Ingredients	Starter: 1-10 d	Grower: 11-24 d	Finisher: 25-35 d
Corn yellow	31.94	34.92	37.01
Wheat	20.00	20.00	20.00
Soy bean meal	39.56	35.67	31.99
Sunflower oil	3.65	5.11	6.86
MCP	1.30	1.10	1.00
Limestone	1.30	1.10	1.10
Premix	1.00	1.00	1.00
DL-Methionine	0.40	0.40	0.36
L-Lysine HCl	0.27	0.22	0.21
Sodium bicarbonate	0.25	0.20	0.20
Sodium chloride	0.18	0.20	0.20
L- Threonine	0.15	0.08	0.07
Total	100	100	100
Calculated levels			
ME kcal/kg	3007	3099	3196
CP %	23.01	21.50	19.99
Lys %	1.44	1.29	1.19
M+C %	0.99	0.95	0.87
Ca %	0.98	0.84	0.81
P %	0.66	0.61	0.57
CF %	2.56	2.46	2.35

Knowing the values for the weight gain and the quantity of consumed combined feed, the feed conversion ratio (FCR) was calculated, expressed in kg CF/kg WG. FCR was calculated for each breeding period (starter, grower and finisher) and for the total breeding period 1-35d.

For the followed indicators, the statistical differences between the control group (T0) and those two experimental groups (T1 and T2) have been highlighted using the ANOVA test combined with the Tukey HSD test.

3. Results and discussion

Dynamics of body weight

The results for dynamics of body weight were obtained after weighing the broiler chickens at: first experimental day, 10 d, 24 d, 35 d respectively and was shown in Table 3. From the data presented in Table 3 and Figure 1, it is noticed that, the chickens from the three experimental variants had a very good uniformity (V=4.27-4.29), and from a statistical point of view, no significant differences have been noticed. At the age of 10 d, in T1, the highest body weight was recorded, this being with 4.21% higher than in group T0, but not ensured statistically for $p>0.05$. At the end of the second breeding period (24 d), T2 recorded the highest body weight, this being with 0.47% higher than T0. Following the application of the variance analysis test, statistical differences have not been noticed ($p>0.05$) between T2 and T0. At the age of 35 d, the body weight is comparable for the three experimental groups, and the differences between them have not been ensured statistically ($p>0.05$).

Table 3. Dynamics of body weight and the differences compared with T0

Specification	T0	T1	T2
Weight at one day (g) X ±Sx	41.75±0.08	41.83±0.16	41.83±0.08
V (%)	4.27	4.29	4.29
Differences %		+0.19	+0.19
ANOVA test		p=0.827	
Tukey test		NS	NS
Weight at 10 d (g) x ±Sx	256.83±22.5	267.66±16.16	252.00±18.83
V (%)	12.38	13.25	11.46
Differences %		+4.21	-1.89
ANOVA test		p=0.728	
Tukey test		NS	NS
Weight at 24 d (g) x ±Sx	1030.50±34.00	1034.00±47.67	1035.41±31.91
V (%)	14.66	12.51	14.35
Differences %		+0.33	+0.47
ANOVA test		p=0.947	
Tukey test statistical meaning		NS	NS
Weight at 35 d (g) x ±Sx	1989.75±34.58	2047.75±33.58	2030.08±25.58
V (%)	11.38	12.31	13.17
Differences %		+2.91	+2.02
ANOVA test		p=0.313	
Tukey test		NS	NS

NS= p>0.05

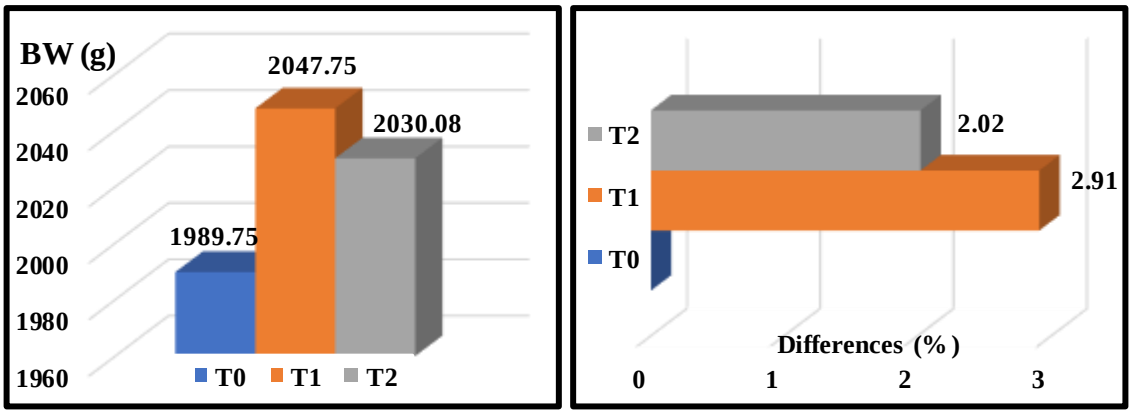

Figure 1. Body weight dynamics and percentage differences

Weight gain dynamics

Based on the evolution of the body weight, the weight gain recorded by the chicken on every breeding phase (Table 4), was determined.

From the data presented in Table 4 and Figure 2, the following are ascertained:

- during the 1-10d period, the highest weight gain was recorded in the experimental group T1 (222.83 g returning to 22.50 g/d), followed by T0 (215.08 g, respectively 21.50 g/d) and T2 (210.16 g, respectively 21.01g/d);
- during the grower period (11-24 d) the same ascending trend was ascertained;
- during the finisher period (25-35d), the highest weight gain was in the experimental group T1 (1013.75g and 92.16 g/d) followed by T2 (994.67g and 90.42 g/d) and T0 (959.25d and 87.20 g/d).

Regarding the average weight gain and the percentage differences recorded in the broilers from the three experimental groups was recording values lower with 1.89% and higher with 4.21%. The variance analysis test did not show statistically ensured differences for p>0.05.

- during the entire breeding period of the broiler chickens (1-35d), the average daily gain was comparable for the three groups, with the highest value in T1 (250 mg oregano essential oil/kg CF) of 57.31 g which was 2.97% higher than T0,

closely followed by T2 (250 mg Tea Tree essential oil/kg CF) of 56.80 g higher with 2.06% compared to T0 in which the lowest average daily gain was recorded (55.65 g). From a statistical point of view, the differences between T0 and experimental groups (T1, T2) were not statistically ensured (p>0.05).

Table 4. Weight gain dynamics and the differences compared with T0

	Specification	T0	T1	T2
1 - 10 d	WG/chicken (g)	215.08±22.41	225.83±6.33	210.16±0.83
	ADG (g)	21.5	22.5	21.01
	Differences %		+4.99	-2.29
	ANOVA test		p=0.727	
	Tukey test		NS	NS
11-24 d	WG/chicken (g)	773.67±11.5	766.33±53.83	783.41±31.08
	ADG (g)	55.26	54.73	55.95
	Differences %		-0.95	+1.25
	ANOVA test		p=0.947	
	Tukey test		NS	NS
25-35 d	WG/chicken (g)	959.25±14.58	1013.75±14.09	994.67±34.5
	ADG (g)	87.20	92.16	90.42
	Differences %		+5.68	+3.69
	ANOVA test		p=0.366	
	Tukey test		NS	NS
1-35d	WG/chicken (g)	1948.00±19.33	2005.91±33.41	1988.25±2.58
	ADG (g)	55.65	57.31	56.80
	Differences %		+2.97	+2.06
	ANOVA test		p=0.311	
	Tukey test		NS	NS

NS=p>0.05

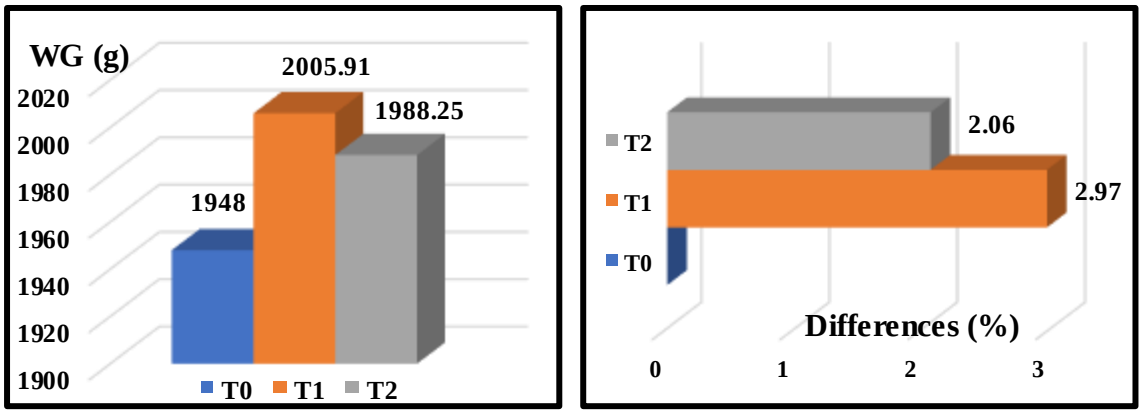

Figure 2. Weight gain dynamics and percentage differences

Dynamics of the feed conversion ratio (FCR)

FCR was obtained based on the ratio between the consumed combined feed quantity during every breeding period and the appropriate weight gain. FCR dynamics, as well as the statistical processing results are shown in Table 5 and Figure 3.

Table 5. Dynamics of the feed conversion ratio (FCR) and the differences compared with T0

	Specification	T0	T1		T2
1-10 d	FCR (kg CF/kg gain)	1.26±0.02	1.20±0.02		1.21±0.06
	Differences %		-4.77		-3.97
	ANOVA test			p=0.616	
	Tukey test		NS		NS
11-24 d	FCR (kg CF/kg gain)	1.61±0.13	1.51±0.1		1.52±0.03
	Differences %		-6.22		-5.6
	ANOVA test			p=0.769	
	Tukey test		NS		NS
25-35 d	FCR (kg CF/kg gain)	1.99±0.12	1.87±0.09		1.89±0.08
	Differences %		-6.04		-5.03
	ANOVA test			p=0.738	
	Tukey test		NS		NS
1-35 d	FCR (kg CF/kg gain)	1.76±0.14	1.65±0.09		1.67±0.01
	Differences %		-6.25		-5.12
	ANOVA test			p=0,643	
	Tukey test		NS		NS

NS= p>0.05

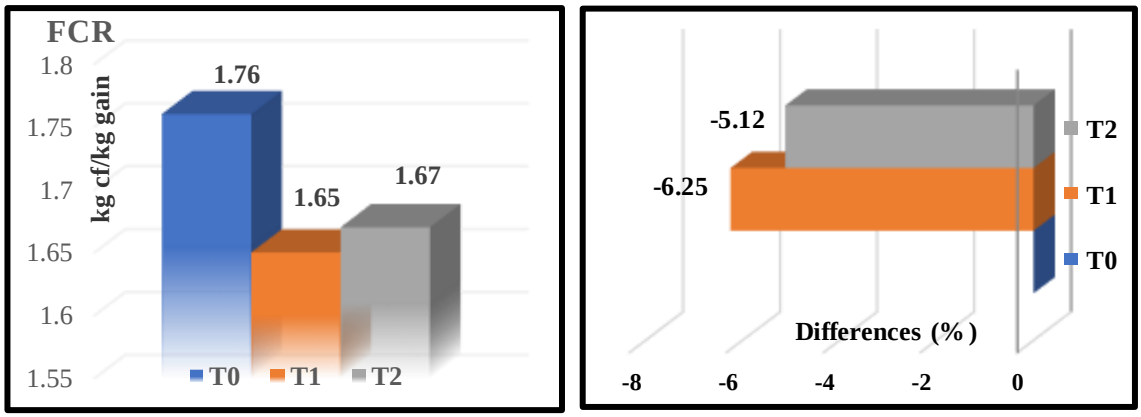

Figure 3. Feed conversion ratio and percentage differences

From the tabular data (Table 5) and Figure 3, it is ascertained that:

- during the breeding phase 1-10 d in experimental groups (T1, T2), FCR was lower as compared with group T0 (-4.77%, in T1; -3.97%, in the case of groups T2. During the following breeding periods (11-24d, respectively 25-35d), for FCR, the same dynamics was kept.
- during the entire breeding period (0-35d), the lowest feed conversion ratio was found in group T1 (1.65 kg CF/kg WG) with -6.25% lower than group T0. Following the statistical processing by means of ANOVA test, non-significant differences were noticed. Following the application of Tukey HSD test, non-significant differences (p>0.05) were noticed between each experimental groups and control group. Similar results were obtained of Eler at al., 2019 [11] which showed that diet supplementation with oregano essential oils improves BWG and FCR. Values obtained in this paper was in agreement with results of Fotea et al., 2010 [15], Stef et al., 2018, [16] which supplemented diets of broiler chickens with oregano essential oil at different levels.

The authors reported positive effect on body weight, daily weight gain and feed conversion ratio.

Also, in the studies of Qu et al., 2019 [17], tea tree essential oil was included in chickens diet. The results obtained showed a positive effect on the increase body weight and immunity.

4. Conclusions

Introducing oregano and tea tree essential oils in diet at 250 mg/kg CF level for broiler chickens had the following effects on the bio productive indices:

- The body weight at 35d, for the experimental groups, was higher as compared with the one recorded in group T0, but the differences were not statistically ensured ($p>0.05$).
- The feed conversion ratio (FCR) has similar values, for the three groups. The lowest FCR was in T1 and T2, compared to the control group T0, the difference not being statistically assured for $p>0.05$.

Following the performed research, the following recommendation can be made: in the case of broiler chickens, the supplementation of the diet with oregano and tea tree essential oils at 250 mg/kg CF, ensures obtaining upper bio productive indices.

References

1.Adaszyńska-Skwirzyńska Michalina, Szczerbińska Danuta, Use of essential oils in broiler chicken production – a review, Ann. Anim. Sci., 2017, 17(2) 317–335.

2. He, X., Hao, D., Liu, C., Zhang, X., Xu, D., Xu, X., Wang, J. & Wu, R., Effect of supplemental oregano essential oils in diets on production performance and relatively intestinal parameters of laying hens, Am. J. Mol. Biol. 2017, 7, 73-85.

3. Criste, R. D., Panaite T., Tabuc C., Sărăcilă M., Effect of oregano and rosehip supplementson broiler (14-35 days) performance, carcass and internal organs development and gut health, Agrolife Scientific Journal, 2017, 6(1).

4. Rewatkar H. N., Agashe, J. L., Jadhao G. M., The effect of supplementation of oregano oil and probiotic on blood biochemicals and immune response of broiler chicken, Journal of Pharmacognosy and Phytochemistry; 2019, 8(2), 1894-1897.

5. Mohitl-Asli, M., Ghanaatparast-RashtI, M., Dietary oregano essential oil alleviates experimentally induced coccidiosis in broilers. Prev. Vet. Med., 2015, 120, 195-202.

6. Balta, I., Pet, I., Stef, L., Corcionivoschi, N., Natural antimicrobials-a real solution to bacterial and viral infections in vitro and in vivo models. Romanian Archives of Microbiology and Immunology, 2021, 80(1), 90-92.

7. Stratakos, A. C., Sima, F., Ward, P., Linton, M., Kelly, C., Pinkerton, L., Stef, L., Pet, I., Corcionivoschi, N., The in vitro effect of carvacrol, a food additive, on the pathogenicity of O157 and non-O157 Shiga-toxin producing Escherichia coli, Food Control, 2018, 84, 290-296.

8. Oniga I., et al., *Origanum vulgare* ssp. vulgare: chemical composition and biological studies, Molecules, 2018, 23, 2077.

9. Bedoya-Serna, C. M., Dacanal, G. C., Fernandes, A. M., Pinho, S. C., Antifungal activity of nanoemulsions encapsulating oregano *(Origanum vulgare)* essential oil: In vitro study and application in Minas Padrão cheese, Braz. J. Microbiol., 2018, 49(4), 929-935.

10. Ri, C. S., Jiang, X. R., Kim, M. H., Wang, J., Zhang, H. J., Wu, S. G., Bontempo, V., Qi, G. H., Effects of dietary oregano powder supplementation on the growth performance, antioxidant status and meat quality of broiler chicks, Ital. J. Anim. Sci., 201716 (2), 246-252.

11. Peng, Q. Y., Li, J. D., Li, Z., Duan, Z. Y., Wu, Y. P., Effects of dietary supplementation with oregano essential oil on growth performance, carcass traits and jejunal morphology in broiler chickens, Animal feed science and technology, 2016, 148-153.

12. Eler, G., Gomes, A. V. C., Trindade, B. S., Almeida, L. S. L., Dilelis, F., Cardoso, V. S., Lima, C. A. R., Oregano essential oil in the diet of broilers: performance, carcass characteristics, and blood parameters, S. Afr. J. Anim. Sci., 2019, 49(4), Pretoria.

13. Puvacca, N., Cabarkapa, I., Bursic, V., Petrovic, A., Acimovic, M., Antimicrobial, antioxidant and acaricidal properties of tea tree (*Melaleuca alternifolia*), J. Agron. Technol. Eng. Manag, 2019, 29–38.

14. Khattak, F., Ronchi, A., Castelli, P., Sparks, N., Effects of natural blend of essential oil on growth performance, blood biochemistry, cecal morphology, and carcass quality of broiler chickens, Poult. Sci., 2014, 93, 132–137

15. Fotea, L., Costăchescu, E., Hoha, G., Leonte D., The effect of oregano essential oil (*Origanum vulgare* L) on broiler performance, Lucrări Ştiinţifice Seria Zootehnie, 2010, 53, 491-494, Iasi.

16. Stef, L., Simiz E., Marcu A., Stef, D., Gherasim, V., Pet, I.; Pătruică S., Ahmadi M., Manciu A., Julean C., The Effect of Essential Oils on the Bioproductive Performance of Broilers, Scientific Papers: Animal Science & Biotechnologies, 2018, 51(1), 43-49.

17. Qu, H., Cheng, Y., Chen, Y., Zhao, Y., Li, J., Wen, C., Zhou, Y., Dietary Tea Tree (*Melaleuca alternifolia*) Oil Supplementation Improves Growth Performance, Cecal Microflora, Immunity, and Antioxidant Capacity of Partridge Shank Chickens, The journal of poultry science, 2019, 56(3), 212-219.