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Original Research

Effect of feeding different levels of lemon seed oil on the production performance of broilers

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ABSTRACT:

This study was conducted at the Abu Ghraib Poultry Research Station of the Agricultural Research Department, Ministry of Agriculture for the period from 22 of January to 25 of February 2018, to study the effect of adding different levels of lemon seed oil to the diet in the production performance of broilers. In this study, three hundred unsexed one day old Ross 308 broilers were reared and randomized into five treatments with three replicates per treatment (20 chick / replicate). Chicks were fed starter, grower and finisher diets and the dietary treatments included T1: control without any addition, T_2, T_3, T_4, and T_5 involved the addition of lemon seed oil by 0.25, 0.50, 0.75 and 1% respectively. The results indicated a significant superiority ($P<0.05$) for the addition of lemon seed oil in the production characteristics of live body weight, weight gain, average feed consumption and feed conversion coefficient during the experiment, especially T_5 (1% lemon seed oil) compared to the control treatment. Regarding breast segment, a significant superiority ($P<0.05$) was noted in T_5, T_4, T_3 compared to the control treatment T_1 while no differences were observed between the different treatments in the major and other minor cuttings. The study concludes that the use of lemon seed oil in broiler diets has led to improve in production performance. Therefore, lemon seed oil can be used as one of the most important feed additives to broiler diets.

Keywords:

Lemon seed oil, Meat broiler, Productive qualities.

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INTRODUCTION

Antibiotics have been used for decades in poultry nutrition to reduce pathological injury and improve their production performance. However, fear of antibiotic-resistant bacterial strains and the accumulation of residues of these antibiotics in poultry products (meat, eggs) have prompted food organizations to ban their use in chicken feed mixtures as catalysts for growth and trend towards commercial diet additives from plant origin, including powders, medicinal plant oils and seed oils of some fruit types, including citrus (Dutra *et al*., 1991). The expected mechanisms of adding plant extracts (oils, powder and seasonings) to promote animal growth include changes in intestinal microbes (Dorman and Deans, 2000), increased digestion, absorption of nutrients (Oetting *et al*., 2006), enhanced nitrogen uptake (Alçiçek *et al*., 2004)) and improved immune response (Namkung *et al*., 2004), which is reflected in the improved production status of birds, which has made it a new strategy for feed additives at present, because its use has more benefits than common commercial antibiotics. They are safer in terms of their impact on the health of both humans and animals.

Essential oils isolated from plant sources have been shown to have a wide range of efficacy including antifungal and antibacterial activity as well as anti-viral antiviral activity (Al-Shamma and Ali, 1989). In addition, essential oils from natural sources are used to conserve feed and improve flavor and some of the essential oils have antioxidant properties as well as used in pharmaceuticals and cosmetics, so they are also called therapeutic oils (Christaki *et al*., 2004; Hussain *et al*., 2010). Lemon seed oil is a therapeutic oil that is of great importance to the health and performance of domestic poultry because it contains many of the medicinal compounds that have therapeutic effects as they are antibacterial, antiviral and antimicrobial. They also have a role in improving the physiological condition of the body and thus it is reflected on improving and activating the health condition and thus improving the productive performance of the birds (Hosseini *et al*., 2013; Akbarian *et al*., 2013). Due to the lack of studies on the use of lemon seed oil in poultry diets therefore, this study was carried out to estimate the effect of feeding different levels of lemon seed oil as a natural stimulant for growth (instead of antibiotics) on the production performance of broilers.

MATERIALS AND METHODS

The study was conducted at Abu Ghraib Poultry Research Station, Ministry of Agriculture, for the period from 22/1/2018 to 25/2/2018. The study examined the effect of using different levels of lemon seed oil on production performance of broilers. 300 Ross 308 rotations were used at one day, randomly distributed in five treatments and three replicates/treatment (20 breeds/ repeater). Chicks fed *ad-libitum* during the experiment and the treatments of the experiments were as follows: T_1 (control without any addition), T_2, T_3, T_4 and T5 included the addition of lemon seed oil by 0.25, 0.50, 0.75 and 1%, respectively. The lemon seed oil used in the study is yellow oil, extracted from the lemon fruit, with no toxic effect, the purity of the substance is 99% and

Table 1. Fatty acids for lemon seed oil and percentages

S. No	Fatty acids	Percentage
1	Myristic acid	0.02
2	Palmitic acid	9.95
3	Palmitoleic acid	0.12
4	Margaric acid	0.05
5	Stearic acid	5.33
6	Oleic acid	40.79
7	Linoleic acid	42.35
8	Arachidic acid	0.61
9	α-Linolenic acid	0.31
10	Paullinic acid	0.18
11	Heneicosylic acid	0.02
12	Behenic acid	0.13
13	Arachidonic acid	0.02
14	Eicosapentaenoic acid	0.08
15	Total energy in lemon seed oil (kcal/l)	8700.50

the metabolic energy was 8700.50 kcal/L. Treatments were obtained by crushing and mixing the ingredients of the diet according to the proportions required for each age group (Tables 1, 2, 3 and 4). The experiment lasted for 35 days and the productivity traits for each week of the experiment such as body weight, weight gain, feed consumption, food conversion coefficient, primary and secondary cutting ratios, relative weight of intestines and abdominal fat for various experimental treatments were measured. The experiment was of completely randomized design to study the effect of treatments in the studied traits and the mean differences between the averages were compared by Duncan Multidisciplinary Test (Duncan, 1955). The statistical program SPSS, 2017 (Bryman and Duncan, 2017) was used to analyze the data statistically.

RESULTS AND DISCUSSION

The average body weight

The results of Table 5 indicated the effect of feeding different levels of lemon seed oil on the body live weight (1-5 weeks) in broilers. There were no significant differences between treatments during the first week. At the second week, T_5 had a significant superiority compared to treatment T_2, T_3 and did not differ significantly from T_1 and T_4, and the significant superiority

Table 2. Percentage of ingredients of starter diet (1-11 days)

S. No	Component	Treatments				
		T_1	T_2	T_3	T_4	T_5
1	Yellow corn	47.5	47.5	47.5	47.5	47.5
2	Wheat	10	10	10	10	10
3	Soybean Meal *	32	32	32	32	32
4	**Protein concentrate	5	5	5	5	5
5	Hydrogenated plant fat	3	2.75	2.5	2.25	2
6	Lemon seed oil	0	0.25	0.5	0.75	1
7	Calcium diphosfate	0.7	0.7	0.7	0.7	0.7
8	Limestone	1.2	1.2	1.2	1.2	1.2
9	Salt	0.1	0.1	0.1	0.1	0.1
10	Methionine	0.25	0.25	0.25	0.25	0.25
11	Lysine	0.25	0.25	0.25	0.25	0.25
12	Total	100	100	100	100	100
	Chemical composition					
13	Energy (kcal)	3059	3059	3058	3057	3056
14	Crude protein (%)	22.6	22.6	22.6	22.6	22.6
15	Crude fat (%)	5.6	5.4	5.1	4.9	4.6
16	Crude fiber (%)	2.7	2.7	2.7	2.7	2.7
17	Calcium (%)	0.97	0.97	0.97	0.97	0.97
18	Phosphorus (%)	0.78	0.78	0.78	0.78	0.78
19	Methionine + cysteine (%)	1.12	1.12	1.12	1.12	1.12
20	Lysine (%)	1.49	1.49	1.49	1.49	1.49

* Soybean protein used by an argentine source with a crude protein content of 48% and 2440 kcal/kg of representative energy
** Proteins used by a Dutch company (imported) Brocon contains 40% raw protein, 2107 kg, 5% raw fat, 2.20% raw fiber, 5% calcium, 2.65% phosphorus, 3.85% lysine, 3.70% methionine, 4.12% methionine + cysteine, 0.42% tryptophan and 1.70% threonine. It contains a mixture of rare vitamins and minerals that ensure the bird's need for these elements.

(P<0.05) of T_5 was continued at the third week compared to T1, recording 877.33, 787.33 g. At week four, T_5 was significantly higher (P<0.05) compared to T_1, T_2 and T_4 as well as a significant superiority (P<0.05) in T_4 on T_1 was shown while the last moral treatment did not differ from T_4. In the fifth week, the table showed significantly higher T_5 (P<0.05) than control coefficients T_2 and T_4 and significantly higher than T_4 (P<0.05) on control treatment, while no significant differences between T_2, T_3 and T_4 was revealed.

Weekly and cumulative increase rate

Table 6 showed no significant differences between the first and fourth week of the birds, and a significant superiority (P<0.05) for T_5 compared with T_2 and T_3 in the second week of the birds. Other treatments, while in the third week we also noticed that the treatment of T_5 significantly (P<0.05) on the treatment of control, which amounted to 498.03 and 420.83 g, respectively. While the control treatment did not differ significantly from T_4. The T_5 treatment did not differ significantly from T_2, T_3 and T_4. In the fifth week, the treatment was significantly higher (P<0.05) compared to the control treatment. No significant differences were observed between the other treatments. Cumulative increase in weight was significantly higher than T_5 in con-

Table 3. Components (percentage) of grower diet (12-21 days)

S. No	Component	Treatments				
		T_1	T_2	T_3	T_4	T_5
1	Yellow corn	50	50	50	50	50
2	Wheat	10	10	10	10	10
3	Soybean Meal *	19	19	19	19	19
4	**Protein concentrate	5	5	5	5	5
5	Hydrogenated plant fat	4	3.75	3.5	3.25	3
6	Lemon seed oil	0	0.25	0.5	0.75	1
7	Calcium diphosfate	0.5	0.5	0.5	0.5	0.5
8	Limestone	1.14	1.14	1.14	1.14	1.14
9	Salt	0.1	0.1	0.1	0.1	0.1
10	Methionine	0.13	0.13	0.13	0.13	0.13
11	Lysine	0.13	0.13	0.13	0.13	0.13
12	Total	100	100	100	100	100
	Chemical composition					
13	Energy (kcal)	3162	3161	3161	3160	3159
14	Crude protein (%)	21.4	21.4	21.4	21.4	21.4
15	Crude fat (%)	6.7	6.4	6.2	5.9	5.7
16	Crude fiber (%)	2.6	2.6	2.6	2.6	2.6
17	Calcium (%)	0.93	0.93	0.93	0.93	0.93
18	Phosphorus (%)	0.84	0.84	0.84	0.84	0.84
19	Methionine + cysteine (%)	0.97	0.97	0.97	0.97	0.97
20	Lysine (%)	1.31	1.31	1.31	1.31	1.31

* Soybean protein used by an Argentine source with a crude protein content of 48% and 2440 kcal/kg of representative energy
** Proteins used by a Dutch company (imported) Brocon contains 40% raw protein, 2107 kg /, 5% raw fat, 2.20% raw fiber, 5% calcium, 2.65% phosphorus, 3.85% lysine, 3.70% methionine, 4.12% methionine + cystine, 0.42% tryptophan and 1.70% threonine. It contains a mixture of rare vitamins and minerals that ensure the bird's need for these elements

Table 4. Components (percentage) of the finisher diet

S. No	Component	Treatments				
		T_1	T_2	T_3	T_4	T_5
1	Yellow corn	56	56	56	56	56
2	Wheat	10	10	10	10	10
3	Soybean Meal *	23	23	23	23	23
4	**Protein concentration	5	5	5	5	5
5	Hydrogenated plant fat	4	3.75	3.5	3.25	3
6	Lemon seed oil	0	0.25	0.5	0.75	1
7	Calcium diphosphate	0.5	0.5	0.5	0.5	0.5
8	Limestone	1.1	1.1	1.1	1.1	1.1
9	Salt	0.1	0.1	0.1	0.1	0.1
10	Methionine	0.15	0.15	0.15	0.15	0.15
11	Lysine	0.15	0.15	0.15	0.15	0.15
12	Total	100	100	100	100	100
	Chemical composition					
13	Energy (kcal)	3217	3216	3215	3214	3214
14	Crude protein (%)	19.1	19.1	19.1	19.1	19.1
15	Crude fat (%)	6.9	6.6	6.4	6.1	5.9
16	Crude fiber (%)	2.5	2.5	2.5	2.5	2.5
17	Calcium (%)	0.90	0.90	0.90	0.90	0.90
18	Phosphorus (%)	0.83	0.83	0.83	0.83	0.83
19	Methionine + cysteine (%)	0.92	0.92	0.92	0.92	0.92
20	Lysine (%)	1.17	1.17	1.17	1.17	1.17

* Soybean protein used by an argentine source with a crude protein content of 48% and 2440 kcal / kg of representative energy;
** Proteins used by a Dutch company (imported) Brocon contains 40% raw protein, 2107 kg / , 5% raw fat, 2.20% raw fiber, 5% calcium, 2.65% phosphorus, 3.85% lysine, 3.70% methionine, 4.12% methionine + cystine, 0.42% tryptophan and 1.70% threonine. It contains a mixture of rare vitamins and minerals that ensure the bird's need for these elements

trol, T_2 and T_4. No significant differences were found between T_2, T_3 and T_4.

Average weekly and cumulative feed consumption

Table 7 shows that T_5 was significantly higher ($P<0.05$) than T_4 at the first week of the birds' age. There were no significant differences between the other treatments. In the third week, T_1 was superior to T_2, which was 637.86 and 587 g respectively. No signifi-

Table 5. Effect of the addition of different levels of lemon seed oil to the diet on the live body weight (g) (average ± standard error) of broilers

S. No	Treatments	Average live body (g)				
		Week 1	Week 2	Week 3	Week 4	Week 5
1	T_1	0.62±128.73	3.21±366.50^{AB}	11.89±787.33^{B}	1.68±1233.36^{C}	7.71±1815.24^{C}
2	T_2	1.90±127.26	6.28±358.23^{B}	25.82±839.66^{AB}	2.90±1290.93^{B}	43.12±1902.56^{B}
3	T_3	0.60±128.33	4.54±360.60^{B}	10.74±848.83^{AB}	7.85±1282.10^{B}	8.79±1963.65^{AB}
4	T_4	0.58±128.56	5.99±365.50^{AB}	1.91±820.46^{AB}	6.77±1270.56^{BC}	13.95±1921.78^{B}
5	T_5	0.98±130.46	5.00±379.30^{A}	11.19±877.33^{A}	28.14±1354.63^{A}	25.87±2004.78^{A}
6	P	N.S	*	*	*	*

Note: T_1, T_2, T_3, T_4 and T_5 indicate the addition of lemon oil by concentrations (0.25, 0.5, 0.75 and 1 g/kg); *Different letters within the same column indicate significant differences at 0.05%); N.S: No significant differences between the experimental treatments.

Table 6. Effect of the addition of different levels of lemon seed oil to the diet on the average of weekly and cumulative weight gain (g) (average ± standard error) of broilers

S. No	Treatments	Weekly average weight gain (g)					Cumulative weight gain (g)
		Week 1	Week 2	Week 3	Week 4	Week 5	Week 1-5
1	T_1	0.72±86.30	2.82±237.76^{AB}	9.90±420.83^{B}	10.55±446.03	6.87±581.87^{B}	7.67±1772.81^{C}
2	T_2	0.74±86.53	5.88±230.96^{B}	19.57±481.43^{A}	28.62±451.26	40.60±611.63^{AB}	44.21±1861.83^{B}
3	T_3	1.06±86.60	4.64±232.26^{B}	7.04±488.23^{A}	3.17±433.26	12.91±681.55^{A}	8.48±1921.92^{AB}
4	T_4	0.77±86.56	5.56±236.93^{AB}	7.90±454.96^{AB}	8.60±450.10	18.87±651.21^{AB}	14.32±1879.78^{B}
5	T_5	1.01±88.23	4.18±248.83^{A}	16.16±498.03^{A}	32.47±477.30	16.56±650.15^{AB}	25.82±1962.55^{A}
6	P	N.S	*	*	N.S	N.S	*

Note: T_1, T_2, T_3, T_4 and T_5 indicate the addition of lemon oil by concentrations (0.25, 0.5, 0.75 and 1 g/kg); *Different letters within the same column indicate significant differences at 0.05%); N.S: No significant differences between the experimental treatments.

cant differences were observed between the other treatments. A significant improvement was observed ($P<0.05$) for T_1 in the fourth week compared to T_3 and T_5. Additionally, no significant differences were found between the other treatments. In the fifth week, the T_1 significantly increased ($P<0.05$) on T_5, T_4, T_3 and did not differentiate significantly from T_2. As for cumulative feed consumption, T_5 was significantly higher ($P<0.05$) on T_1 and T_2 and there was no significant difference between T_5, T_4, T_3.

Weekly and cumulative food conversion efficiency rate

Table 8 indicates that there is no significant effect of the addition of lemon seed oil at the first, fourth and fifth week of birds age in the rate of feed conversion coefficient. In the second week, T_3 and T_2 (1.19 and 1.21) were significantly higher ($P<0.05$) compared with T_1 (1.04). No significant differences were observed

Table 7. Effect of the addition of different levels of lemon seed oil to the diet on the average of weekly and cumulative feed intake (g) (average ± standard error) of broilers

S. No	Treatments	Weekly feed intake (g)					Cumulative feed consumption (g)
		Week 1	Week 2	Week 3	Week 4	Week 5	Week 1-5
1	T_1	0.40±100.60^{AB}	9.81±247.23	14.51±637.86^{A}	1.38±715.56^{A}	18.00±1020.30^{A}	5.39±2721.57^{B}
2	T_2	0.60±101.60^{AB}	9.73±276.76	10.25±587.00^{B}	7.45±715.03^{A}	51.59±1020.06^{A}	57.28±2700.46^{B}
3	T_3	0.75±101.03^{AB}	9.75±282.16	20.87±629.96^{AB}	1.06±703.36^{B}	24.50±1165.89^{B}	27.96±2882.42^{A}
4	T_4	3.96±98.00^{B}	19.17±264.83	14.23±604.36^{AB}	0.13±707.16^{AB}	16.33±1161.60^{B}	40.22±2835.96^{A}
5	T_5	0.76±104.56A	11.73±285.66	8.94±620.70^{AB}	0.96±702.00^{B}	11.43±1143.17^{B}	15.72±2856.10^{A}
6	P	*	*	*	*	N.S	*

Note: T_1, T_2, T_3, T_4 and T_5 indicate the addition of lemon oil by concentrations (0.25, 0.5, 0.75 and 1 g/kg); *Different letters within the same column indicate significant differences at 0.05%); N.S: No significant differences between the experimental treatments.

Table 8. Effect of the addition of different levels of lemon seed oil to the diet on the average of weekly and cumulative feed conversion coefficient (g/g) (Average ± standard error) of broilers

S. No	Treatments	Weekly feed conversion coefficient (g/g)					Cumulative feed consumption (g/g)
		Week 1	Week 2	Week 3	Week 4	Week 5	Week 1-5
1	T_1	0.01±1.16	0.05±1.01^{B}	0.00±15.1^{A}	0.04±1.60	0.03±1.75	0.00±1.53^{A}
2	T_2	0.01±1.17	0.03±1.19^{A}	0.06±1.22^{B}	0.09±1.59	0.03±1.67	0.00±1.45^{B}
3	T_3	0.00±1.16	0.04±1.21^{A}	0.05±1.29^{B}	0.01±1.62	0.01±1.71	0.01±1.49^{AB}
4	T_4	0.04±1.13	0.05±1.11^{AB}	0.05±1.33^{B}	0.02±1.57	0.07±1.78	0.01±1.51^{AB}
5	T_5	0.00±1.18	0.02±1.14^{AB}	0.04±1.25^{B}	1.10±1.48	0.04±1.76	0.02±1.45^{B}
6	P	N.S	*	*	N.S	N.S	*

Note: T_1, T_2, T_3, T_4 and T_5 indicate the addition of lemon oil by concentrations (0.25, 0.5, 0.75 and 1 g/kg); *Different letters within the same column indicate significant differences at 0.05%); N.S: No significant differences between the experimental treatments.

between the other treatments. The table also showed that T_1 significantly (P<0.05) was superior to the other treatments at the third week. In terms of cumulative feed conversion coefficient, T_1 (1.53) was significantly higher (P<0.05) on T_2 and T_5 (1.450 and 1.456 g respectively). No significant difference was observed between T_4, T_3, and T_2 at the same time.

The significant improvement (P<0.05) in the weight of the live body weight as well the weekly and cumulative weight increase in treatment supplemented with lemon oil, especially T_5 (1%), may be due to the type of unsaturated fatty acids found in the oil, namely linoleic acid, α-linolic, eicosapeutaenoic, which are classified as omega-3 fatty acids and which have an important role in the body and bio-processing, thus positively affecting the digestion and absorption efficiency and hence the improvement in weight gain and the final body weight rate compared to the rest of the other treatments (Seyed *et al*., 2010; Monfaredi *et al*., 2011; Mohammadreza *et al*., 2013). On the one hand, these oils help restore the microbial balance and thereby increase feed absorption, which can be attributed mainly to the

Table 9. Effect of the addition of different levels of lemon seed oil on the relative weight of major and minor cuttings (%) (average ± standard error) of broiler carcasses at the age of 35 days

S. No	Treatments	Relative weight of major cuttings			Relative weight of minor cuttings		
		Breast	Thigh	Drumstick	Wings	Back	Neck
1	T_1	0.19±34.89^{B}	12.84±0.50	0.77±11.45	0.97±9.76	1.62±23.79	0.60±7.21
2	T_2	0.14±35.70^{B}	13.63±0.91	0.46±12.38	0.28±9.18	0.98±23.35	0.99±5.70
3	T_3	0.45±38.51^{A}	11.76±0.66	0.16±11.13	0.40±9.02	1.84±19.54	0.84±5.01
4	T_4	0.95±40.66^{A}	13.66±2.08	0.40±12.25	0.56±8.98	1.55±19.45	0.93±5.10
5	T_5	1.41±39.70^{A}	12.61±0.74	0.40±11.30	0.57±9.23	1.22±22.17	0.84±5.07
6	P	*	N.S	N.S	N.S	N.S	N.S

Note: T_1, T_2, T_3, T_4 and T_5 indicate the addition of lemon oil by concentrations (0.25, 0.5, 0.75 and 1 g/kg); *Different letters within the same column indicate significant differences at 0.05%); N.S: No significant differences between the experimental treatments.

Table 10. Effect of the addition of different levels of lemon seed oil to the diet on the dressing percentage, edible cuttings, and relative weight of the abdominal fat % (Average ± standard error) of broiler carcasses

S. No	Treatments	**The dressing percentage	Relative weight of the heart	Relative weight of the gizzard	Relative weight of the spleen	Relative weight of the abdominal fat
	Transactions	5.87±63.93[b]	0.21±0.77	0.36±1.56	0.18±2.01	0.18±1.47[a]
1	T_1	0.52±75.30[a]	0.01±0.46	0.12±1.59	0.22±2.06	0.08±0.51[b]
2	T_2	0.91±74.32[a]	0.04±0.50	0.11±2.03	0.13±2.14	0.07±0.35[b]
3	T_3	0.11±74.66[a]	0.05±0.63	0.03±1.84	0.08±1.97	0.22±0.45[b]
4	T_4	0.79±74.84[a]	0.01±0.57	0.14±1.71	0.34±2.23	0.11±0.29[b]
5	T_5	5.87±63.93[b]	0.21±0.77	0.36±1.56	0.18±2.01	0.18±1.47[a]
6	P	*	N.S	N.S	N.S	*

Note: T_1, T_2, T_3, T_4 and T_5 indicate the addition of lemon oil by concentrations (0.25, 0.5, 0.75 and 1 g/kg); *Different letters within the same column indicate significant differences at 0.05%); N.S: No significant differences between the experimental treatments.

effective terpenoids compounds (Monfaredi *et al*., 2011; Barbour *et al*., 2013) which are important in the process of feed conversion (Monfaredi *et al*., 2011; Mathlouthi *et al*., 2012). These compounds also promote the production of digestive enzymes, which improves digestion and absorption of nutrients (Gopi *et al*., 2014). Limonene, Terpinene, Pinene and Geranial were classified as terpenoids, which play an important role in improving gastrointestinal channel secretion by stimulating gastrointestinal tract secretions such as yellow pigment and mucus and improving the efficiency of enzymes (Platel and Srinivasan, 2001; Manzanilla *et al*., 2004). Studies have shown that citrus fruits (especially oranges and lemons) are rich in phenols (Akbarian *et al*., 2013). Phenolic compounds exhibit a lot of antimicrobial activity and it has an antimicrobial effect by altering the intestinal ecosystem to affect nutrient efficiency, thereby increasing body weight and improving the food conversion coefficient within the bird body (Hosseini *et al*., 2013).

Major and minor pieces

Table 9 shows no significant differences in the relative weights of the femoral link, wing, back, and neck when adding different levels of lemon seed oil to the diet, while the superiority of T_4 ($P<0.05$) in the relative weight of the chest segment, which amounted to 40.66% Both T_1 and T_2 were recorded with 34.89 and 35.70%, respectively.

Table 10 shows no significant differences in the addition of lemon seed oil to the relative weight of the heart, liver and gizzard, while T_2, T_3 and T_4 shows a significant superiority compared with T1 (63.0%) and a significant decrease ($P<0.05$) in the relative weight of the abdominal fat for the addition of oil compared to T_1 (1.47%) was noted.

The significant increase ($P<0.05$) in the dressing percentage without the internal edible parts when adding the lemon seed oil to the diet may be due to the fact that the amount of energy obtained from the oil was greater in digestion and absorption depending on the nature of unsaturated fatty acids which were greater than the saturated fatty acids compared to the treatment of control and the emergence of that difference on the increase in the growth of birds and increase the final body weight in them and the existence of a positive correlation coefficient between body weight and the dressing percentage (Fayyad and Naji, 1989). These findings agreed with Dutra *et al*. (1991), Firman *et al*. (2008), Ferrini *et al*. (2008), Jeffre (2010) and Monfaredi *et al*. (2011), who noted that vegetable oils contain unsaturat-

ed fatty acids greater than fat, thus metabolic energy was greater than the fat and the positive reflection on the growth rate and the final weight of the broilers and then the higher dressing percentage due to the positive correlation with the body weight where the higher body weight, the higher dressing percentage. The significant decrease in abdominal fat may be due to the fact that digestion and absorption of fats or oils vary depending on the type of oil or fat in the diet, as the addition of essential oils to the diet improves the specifications of the carcass by reducing the level of fat deposited all over (Sanz *et al*., 2000; Pesti *et al*., 2002; Newman *et al*., 2002). In addition, it improves the digestion efficiency of feedstuffs and reduces the amount of feed intake.

CONCLUSION

The incorporation of lemon seed oil in broiler diets improved the production performance of the broilers. Therefore, lemon seed oil can be used as one of the most important feed additives to broiler diets.

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