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Effect of Different Levels of Origanum Majorana Leaves Powder on Performance and Carcass Characteristics of Broiler Chickens

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ABSTRACT

The prohibition uses of antibiotics and coccidiosis opens the door for research into the natural alternatives to be used to enhance animal performance. Origanum Majorana (OM) is a native plant in the Middle East which have many secondary nutritional components that affect broiler performance. Three hundred and seventy-five, one-day-old (Ross 308) broiler chickens were distributed to five treatments with three replicates per treatment. Treatment T1 was the positive control which had fed with a coccidiostat. T2 was the negative control, feeding without coccidiostat. T3, T4, and T5 had the same feed as T2 with 0.5%, 1%, and 1.5% of added OM leaf powder. The rearing period was extended to 35 days. Performance parameters were measured weekly. Four birds from each pen were slaughtered and carcass cuts were weighed. Breast and thigh meat samples were stored at 5Co for 7 days, and meat color and pH were measured at days 1, 3, 5, and 7 of slaughtering. Feeding OM at a level of 0.5% showed a significant ($P<0.05$), increase in total feed intake and final body weight (3920 g, 2630.15g) compared to other groups. The lowest significant FCR was obtained in T4 on weeks 3, 4, and 5 (1.34, 1.33, and 1.51, respectively). There were no significant differences between treatments on thigh and breast L*, a*, b*, and meat pH. The L* value (59.19) for breast tends to be improved ($P=0.0873$) due to the use of 0.5% of OM In all treatments means the values of a*, b*, and meat pH increased significantly during the storage period while the value of L* was significantly reduced. Using OM will enhance the performance of broiler chickens and may improve the meat quality when it is used as a natural component substitute for coccidiostat and antibiotics.

Keywords: Origanum Majorana, Broiler chickens, Performance, Meat Quality.

INTRODUCTION

Using antibiotics as a feed additive to enhance the performance of poultry led to an increase in the resistance to pathogens and the accumulation of antibiotic residues in animal body tissues (Azeem *et al*., 2014). Hayajneh and Alananbeh., (2018) showed that the awareness in the Jordanian population of the antibiotic residue in food is increasing and reflected as the need for its prevention. The use of anticoccidial drugs for several years as prevention and treatment of coccidiosis leads to an organism resistant to these drugs (Sundar *et al*., 2017). An uplift concern about these drugs effects on humans, animals, and environmental status increased continually (Qaid *et al*., 2020). As a result, the prohibition of using antibiotics in poultry feeds was applied (Saber *et al*., 2018) and the concern of prohibition of coccidiosis drugs was increased **(**Peek and Landman, 2011). Natural medical plants have been used as feed additives for poultry for a long time

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(Guo *et al*., 2004; Adil *et al*., 2010; Hassan *et al.*, 2015; Yildirim *et al*., 2018). *Origanum Majorana* L. (OM) from the family Lamiaceae (syn. *Majorana hortensis Moench*) is a native plant in the Mediterranean region, and commonly known as sweet marjoram (Charles, 2013). This plant had many benefits for humans and animals as oil and as plant leaves powder. Bina *et al*., (2017) summarized the phytochemical constituents of OM and reported that its main active components are carvacrol, thymol, sabinene, γ-terpinene, geraniol, linalool, camphene, α-thujene, rosmarinic acid, naringin, hesperetin, borneol, β-caryophyllene, and β-bisabolene. Many effects due to the use of OM can be seen, it acts as an antioxidant (Erenler *et al.,* 2016; Deuschle *et al.,* 2018), antibacterial (Omara *et al.,* 2014), anticoagulant, anti-inflammatory (Arranz *et al.,* 2015), and anticoccidial (Mohamed *et al.,* 2021). Habib *et al*., (2012) substituted feed antibiotics with 2 or 4 g/kg of OM powder for broiler chickens and found that it increased feed intake and enhanced the immunological parameters for birds. Ali (2014) reported that the addition of OM powder to broilers' feed at a level of 1.5% enhanced productive performance through increasing weight gain, and feed intake, and reducing the FCR. Furthermore, Shawky *et al*., (2020) administrated 2% marjoram powder to the diet of broiler chickens and observed a reduction in FCR, and enhancement in weight gain after the second week of the rearing period. There is limited research that focuses on the effect of using marjoram powder on the performance of broiler chickens and limited information about its effect on carcass characteristics. The objective of this research is to investigate the effect of using different levels of OM leaf powder on the performance of broiler chickens and carcass characteristics fed a ration free of antibiotics and coccidiostat.

Materials and Methods

All the animal care instructions that were approved by the University of Jordan were taken into consideration. Three hundred and seventy-five, one-day-old (Ross 308) broiler chickens were distributed to five treatments, each treatment had three replicates with 25 birds/replicate. Treatment one was the positive control which had fed with a coccidiostat. T2 was the negative control without coccidiostat. T3, T4, and T5 had the same feed as T2 plus (0.5%, 1%, and 1.5% of OM, respectively) a substitution for corn. Feed composition is shown in (Table 1). Feed was formulated according to the recommendation of (Ross 308) manual. Starter feed was offered from day 1 to day 12 of the rearing period, a grower ration was given from day 13 until day 22 and a finisher diet was offered until the end of the experiment. Feed and water were offered ad-libitum.

The study was conducted in an open rearing house at the Agricultural research field on the University of Jordan campus. Broilers were reared according to the Ross 308 manual. Birds were kept in a separate pen overall the experiment. The environmental temperature was 32C^{o} at the beginning of the trial. It was reduced gradually to reach 22C^{o} at week 3 of rearing and stabilized until the end of the trial.

Mortality was registered every day and used to calculate the corrected feed conversion ratio. Bird weight and feed intake were measured weekly for each replicate, and corrected FCR was calculated as well. On day 35, four birds from each replicate were slaughtered. Live weight, hot carcass weight, and weight of liver, heart, and gizzard were taken for each bird. Carcasses were kept in the refrigerator at 5C^{o} for 24 hours, then the cold carcasses' weight, cuts, and fat pad were weighed for each bird, and each cut percentage was calculated relative to body weight (Abdullah *et al.,* 2009).

Two breasts and two thighs from each replicate were separated and kept in the refrigerator for 7 days. Meat color and pH were measured on days 1, 3, 5, and 7 of the storage periods. The value of L* (lightness), a* (redness), and b* (yellowness) was taken through the chlorometer Croma meter CR-400 (Konica Minolta Business Technology, Tokyo, Japan). Duplicates measured were taken from the breast and the thigh from places that were free from any obvious blood-related defects such as bruises, hemorrhages, or full blood vessel defect (Fletcher *et al*., 2000).

The pH value was determined for the breasts and the thighs on the same days using a pH meter (Iso LAB labrogerate pH) after homogenization of meat samples from each breast and each thigh with distilled water at 1:10 ratio by electric homogenizer (ASE laboratory) according to (Alirezalu *et al*., 2019).

Statistical analysis was conducted by using the GLM procedure of the Statistical Analysis System (SAS, 2004). LSD test was used to compare means of significant effects at ($P< 0.05$).

Results and Discussion

Body weight and weight gain

The effect of adding OM to broiler feed during the rearing period appeared significantly after the third week of rearing. After this age, the intestines of broilers will develop, and the digestion of feed is better than younger age (Hughes, 2001). There was no significant difference between the treatments in body weight gain ($P= 0.0946$) but it tends to be higher in T3 at the last two weeks of rearing. The results showed a significant difference at ($P \leq 0.05$) in bird body weight between the treatments in weeks 4 and 5 of the rearing periods. In week 4 the highest significant weight was for T3 which was (1864.28g). Ali (2014) reported that feeding OM on a level of 0.5% did not significantly affect birds' body weight in the 3rd week of the rearing period, while on day 42 the best body weight was significant for the groups that had 1%, 1.5% of OM (2516.7g and 2511.7g, respectively). These results were similar to our results in week 5 for T3, and T5 which were (2630.15g, and 2570.66 g, respectively). Furthermore, Abdel-Wahab (2019) reported a significant increase in body weight at days 21, and 38 of the rearing periods for the groups that had 1.5% OM (1016.3g and 2326.8g, respectively). This increase in body weight was due to the presence of phytochemicals in the leaf powder of OM which act as growth promoters through enhancing the digestion and absorption action in the intestine.

Feed Intake and FCR

The significant effect of feeding OM leaf powder appears clearly after the third week of rearing as shown in (Figure 1). This effect was reported by (Ali. 2014, Khattab *et al.*, 2018; Shawky *et al.*, 2020). Feeding 0.5% OM leaf powder significantly increased feed intake at weeks 4 and 5 (1202.56 g, and 1292.34g per bird, respectively). Chang *et al*., (2017) reported that feeding oregano powder at a level of 150 mg/increased feed intake of broiler chicken. Conversely, Abdel-Wahab (2019) found that feeding OM leaf powder at different levels resulted in a decreased feed intake during all the rearing period. The lowest feed intake during the rearing period appeared clearly on week 4 in the group that received 1% of OM leaf powder, where the feed intake was (892.3g). Several phytogenic components in OM like carvacrol affect feed consumption by enhancing digestive enzymes secretion and increasing the motility of the digestive tract (Alagawany *et al*., 2015). Ali (2014) showed that there were no significant differences between 1%, and 1.5% of OM leaf powder on feed intake, and these levels registered lower feed intake than the control groups. Abdel-Wahab (2019) reported that by increasing the level of OM leaf powder there was a significant reduction in feed intake (2851.59g, and 2811.02g) for the groups that had 1%, and 1.5% in the period 22-38 days of the rearing period.

The results showed a significant difference in CFCR between the treatments in the rearing period after the third week and lasted until the end as shown in (Figure 1). These differences in FCR occurred due to the variation in feed intake between the treatments. The lowest significant FCR was obtained in the T4 group (1.34, 1.33, and 1.51) at weeks 3, 4, and 5 respectively. These results agreed with (Ali, 2014) who reported that the lowest FCR was due to feeding 1, and 1.5% OM leaf powder compared to the group that had 0.5% OM during the overall rearing period. Khattab *et al.*, (2018) reported that feeding OM leaf powder at a level of 1.5% reduced the FCR in the period between 21 – 42 days in comparison to the control group where it was (1.78, and 2.07, respectively). There were no significant differences between the treatment in FCR for the overall rearing period (1.37, 1.34, 1.51, 1.36, and 1.4, for T1, T2, T3, T4, and T5, respectively). This result was similar to Abdel-Wahab (2019) who reported

no significant differences between the control and groups that had different levels of OM leaf powder. However, Shwaky *et al*., (2020) reported a reduction in FCR due to feeding OM leaf powder at a level of 2% compared to the control group which was (1.47, and 1.57, respectively).

Carcass cuts and dressing percentage

After slaughtering, samples were taken according to the average of each group. Feeding OM at a level of 0.5% significantly increased the marketable birds body weight by 9.82% compared to the positive control group. The increase in body weight was reflected in carcass weight and liver weight but it did not significantly affect the percentages of heart and liver. These results agreed with Abdel-Moneim *et al.,* (2015), where they did not find any significant difference in the relative weights of gizzard, heart, and liver due to marjoram extract supplementation. The dressing percentage was between 75.09 to 76.82% with no significant difference between the groups as shown in (Table 2). There was no significant effect of feeding OM on cut percentage. Gallegos *et al*. (2019) found that supplementing the diet with Mexican Oregano Oil did not affect the hot and cold carcass yields and dressing percentage as well. Eler *et al.* (2019) reported that oregano essential oil did not affect breast, legs, wings, and back percentage in relation to body weight.

Meat color and pH

For all treatment groups there was a significant increase in pH value during the storage period for breast and thigh meat. There were no significant differences between the treatments in the meat color parameters L*, a*, and b* for the thigh during the storage period, as well as the breast meat for a* and b* values. There was a significant decrease in L* for all treatment means during storage. Alternatively, the value of a* and b* increased significantly during the storage period for thigh and breast cuts as shown in (Figures 2 and 3). Post-slaughter there will be a depletion of glycogen and an increase in lactic acid that can't be removed due to lack of blood circulation, resulting in a meat pH of around 5.5. (Greaser,1986). The denaturation of protein in the meat increases the pH and increases the heme concentration resulting in the decrease of the L* value with a minimal increase in the a*, and b* values (Mir *et al*., 2017). Myoglobin is the sarcoplasmic heme protein primarily responsible for the meat color and its change during the storage period (Surendranath *et al*., 2013)

There is a tendency (*P* value = 0.087) effect due to feeding OM leaf powder at a level of 0.5% on breast L* value which was the highest value in comparison with the other groups in a value reached 59.19. Ahmed *et al*., (2015) found that adding 0.8% OM leaf powder to the feed of turkey increased the L* value of breast meat which reached 67.29. The inclusion of 0.5% OM increased the antioxidant components in the meat and reduce the protein denaturation which resulted in a higher L* value during the storage period compared to the other groups. High levels of antioxidants are reported in OM which prevents the production of free radicals that maintain the quality of meat (Deuschle *et al.,* 2018).

In conclusion, the prohibition of antibiotics and the reduced use of anticoccidial drugs force the community to find natural alternative products that have no harmful effects on the birds and no residual effects on the consumers. OM is one of the promising alternative herbs that can be used in broiler feed instead of coccidiostat and antibiotics. The use of OM resulted in an enhanced feed intake and increased body weight gain and marketable weight, in addition to reducing the oxidation of breast meat which maintained the meat quality throughout the marketing storage period. Further studies are needed to assess its effect on a challenged broiler against coccidiosis to clarify its effect on intestinal health and its resistance.

Table 1: Ration composition% and calculated analysis:

	Starter				**Grower**				**Finisher**			
Ration component%	*C-	OM 0.5%	OM 1%	OM 1.5%	C-	OM 0.5%	OM 1%	OM 1.5%	C-	OM 0.5%	OM 1%	OM 1.5%
Corn	58.9	58.4	57.9	57.4	62.3	61.8	61.3	60.8	67.0	66.5	66.0	65.5
SBM	36.5	36.5	36.5	36.5	32.5	32.5	32.5	32.5	27.5	27.5	27.5	27.5
Soya oil	5	5	5	5	1.3	1.3	1.3	1.3	1.6	1.6	1.6	1.6
CaCO3	1.6	1.6	1.6	1.6	1.4	1.4	1.4	1.4	1.4	1.4	1.4	1.4
Concentrate 2.5%	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
OM	0.00	0.5	1	1.5	0.00	0.5	1	1.5	0.00	0.5	1	1.5
Calculated Analysis												
M E Kcal/Kg	2920	2901	2885	2867	3000	2988	2975	2957	3075	3060	3040	3023
Crude protein %	22	22	22	22	20.6	20.6	20.6	20.6	18.5	18.5	18.5	18.5
Calcium %	0.94	0.94	0.94	0.94	0.85	0.85	0.85	0.85	0.83	0.83	0.83	0.83
Available P %	0.48	0.48	0.48	0.48	0.47	0.47	0.47	0.47	0.45	0.45	0.45	0.45
****Dig. Lysine %**	1.3	1.3	1.3	1.3	1.22	1.22	1.22	1.22	1.1	1.1	1.1	1.1
Dig Methionine %	0.6	0.6	0.6	0.6	0.58	0.58	0.58	0.58	0.56	0.56	0.56	0.56
Dig. Methionine and cysteine	0.9	0.9	0.9	0.9	0.84	0.84	0.84	0.84	0.8	0.8	0.8	0.8
Dig Threonine %	0.85	0.85	0.85	0.85	0.8	0.8	0.8	0.8	0.74	0.74	0.74	0.74
Dig. Valine %	0.95	0.95	0.95	0.95	0.88	0.88	0.88	0.88	0.8	0.8	0.8	0.8
Sodium %	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16	0.16
Chloride	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22	0.22

The concentration includes the following per Kg: CP: 26.8%, EE: 0.3%, Ash: 51%, Ca: 7.1%, Ava P: 13%, Methionine: 11.9%, Methionine + cystine: 11.9%, Lysine; 9.8%Threionine: 5.9%, Valine: 1.6%, Sodium: 5.3%, Chloride: 6.43%. Vitamin A: 440000 IU, Vitamin D3:198000 IU, Vitamin E: 2640 mg, Vitamin K: 135 mg, Vitamin B1: 112 mg, Vitamin B2: 290 mg, Vitamin B6: 144 mg, Vitamin B 12: 750 mg, Biotin 7920 mcg, Vitamin B9: 85 mg, Vitamin B3: 2640mg, Vitamin B5: 7947 mg, Ferrous carbonate: 804 mg, Cupper: 640 mg, Zinc methionine: 1584 mg, Zinc Oxide: 4030 mg, Iodine: 50mg, Selenium: 12 mg, Manganese oxide: 4800 mg. phytase enzyme, Enzymes (Protease, Amylase, Xylanase).

*The negative control (c-). The positive control had a coccidiostat in the premix in a level of 2400mg/kg.

** Dig: digestible, OM *(Origanum Majorana*)

Table 2: The effect of feeding different levels of OM on carcass characteristics

Item	Live body weight (g)	Carcass weight (g)	Gizzard weight (g)	Liver weight (g)	Heart weight (g)	Gizzard %	Liver %	Heart %	Dressing %
T1	2349.5 [b]	1804.75[b]	23.4	52.33[b]	13.00	0.995	2.23	0.55	76.82
T2	2487 [a]	1907.17[a]	23.4	55.67[a]	13.08	0.907	2.25	0.52	76.77
T3	2605.17[a]	1972.83[a]	24.0	59.5[a]	13.33	0.925	2.29	0.61	75.92
T4	2467.42[a]	1858.5[a]	24.92	57.08[a]	13.25	1.010	2.31	0.54	75.37
T5	2545.67[a]	1912.00[a]	27.08	56.83[a]	13.08	1.071	2.24	0.51	75.09
PV	0.0009	0.004	0.111	0.006	0.379	0.1888	0.266	0.892	0.661
RMSE	231.55	179.34	4.767	8.371	2.395	0.6002	0.15	0.841	3.305

a, b means with different letters are significantly different at P≤0.05 T1: Positive control.
T2: Negative control. T3: 0.5% OM. T4:1% OM. T5: 1.5% OM

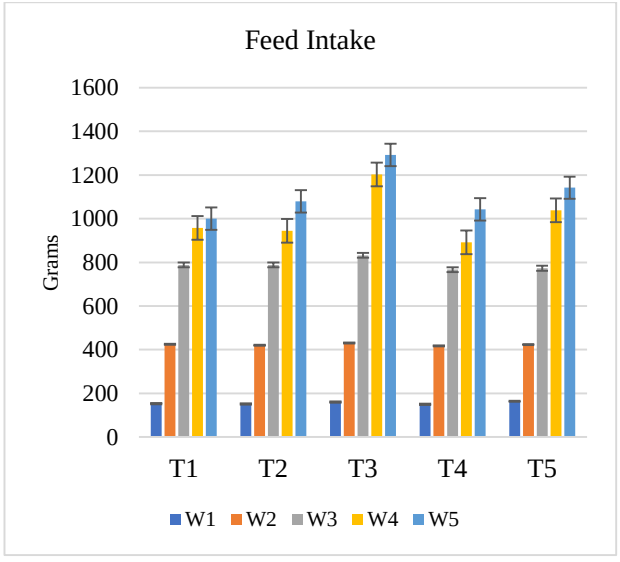
Table 3: The effect of feeding different levels of OM on carcass cuts percentage to cold carcass weight.

Item	Cold carcass weight (g)	Fat Pad %	Wing %	Thigh %	Breast %	Back%	Neck %
T1	1795.58 [b]	1.276	9.498	25.805	35.55	11.955	12.313
T2	1898.58[a]	1.635	9.504	26.040	37.06	13.062	12.597
T3	1965.67 [a]	1.385	9.509	27.315	35.910	12.477	13.296
T4	1852.08 [a]	1.313	9.513	26.255	36.403	12.945	13.443
T5	1909.08 [a]	1.382	9.510	26.634	36.82	12.414	13.125
P-value	0.003	0.244	0.07	0.207	0. 22	0.07	0.306
RMSE	179.39	0.326	0.590	1.458	1.994	1.243	1.208

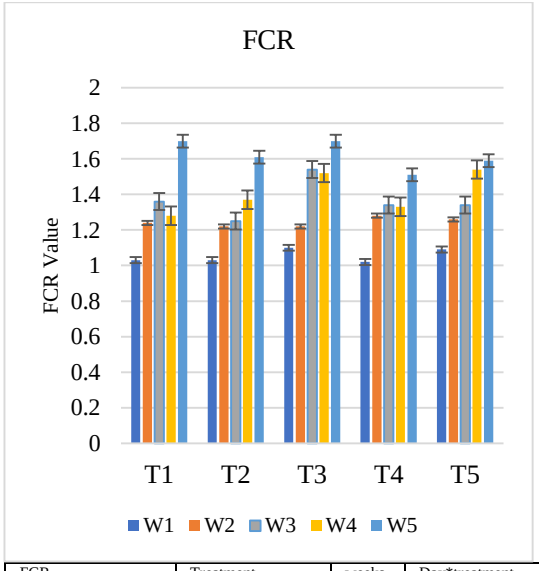
a, b means with different letters are significantly different at P≤0.05 T1: Positive control.
T2: Negative control. T3: 0.5% OM. T4:1% OM. T5: 1.5% OM

Weight gain	Treatment	weeks	Day*treatment
P value	0.0946	<.0001	0.1317
RMSE	38.24		

Bird Weight	Treatment	weeks	Day*treatment
P value	0.0388	<.0001	0.0288
RMSE	54.369		



Feed Intake	Treatment	weeks	Day*treatment
P value	0.0109	<.0001	0.0024
RMSE	80.192		

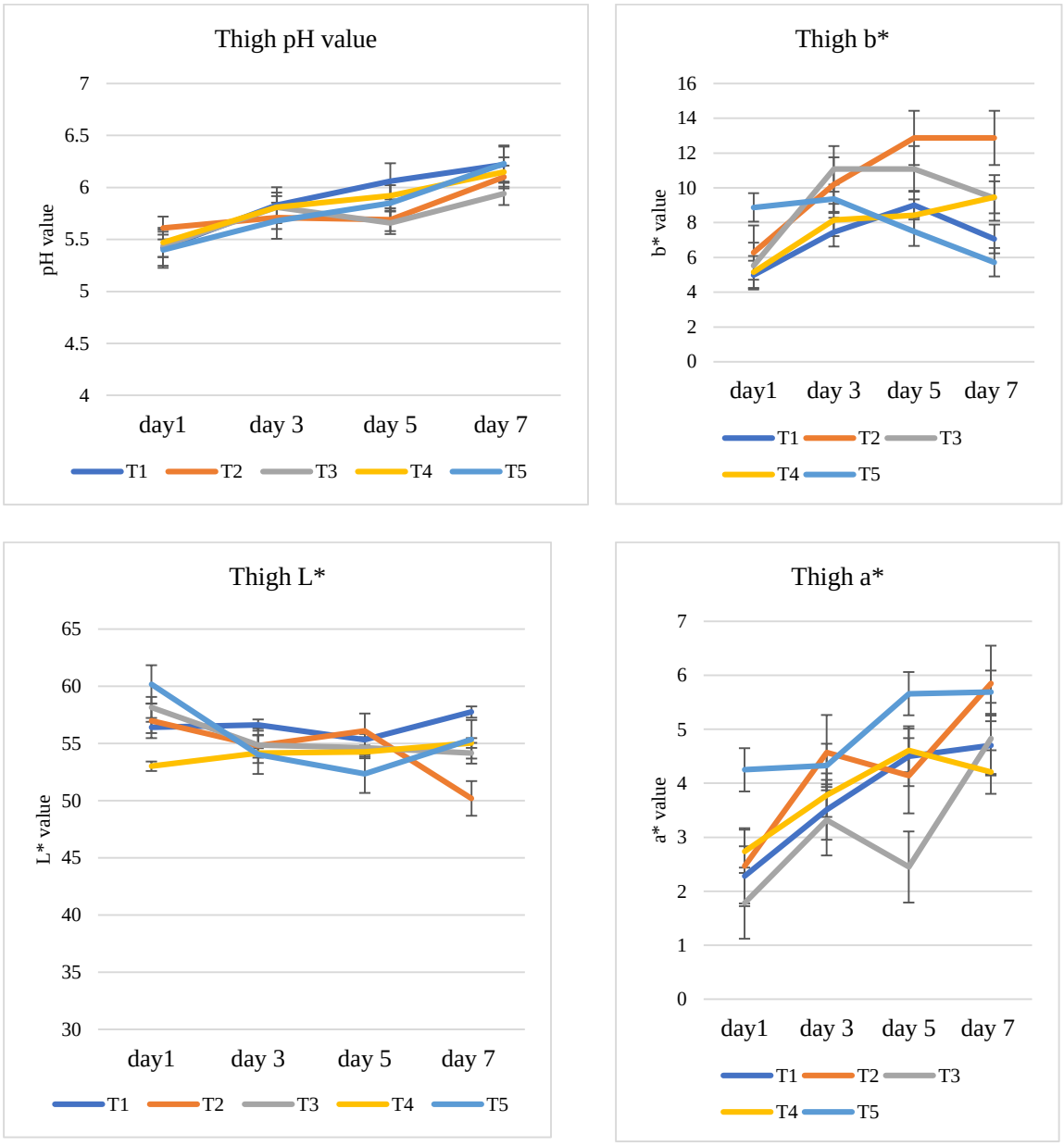


FCR	Treatment	weeks	Day*treatment
P value	0.2131	<.0001	0.0315
RMSE	0.1362		

Significant at p≤0.0, T1: Positive control.

T2: Negative control. T3: 0.5% OM. T4:1% OM. T5: 1.5% OM

Figure 1: Effect of feeding different levels of OM on bird weight, weight gain, feed intake, FCR during the rearing period**.**



For pH p value for treatments: 0.3606, days: <.0001, Treatment* Day:0.4606 and RMSE: 0.324.

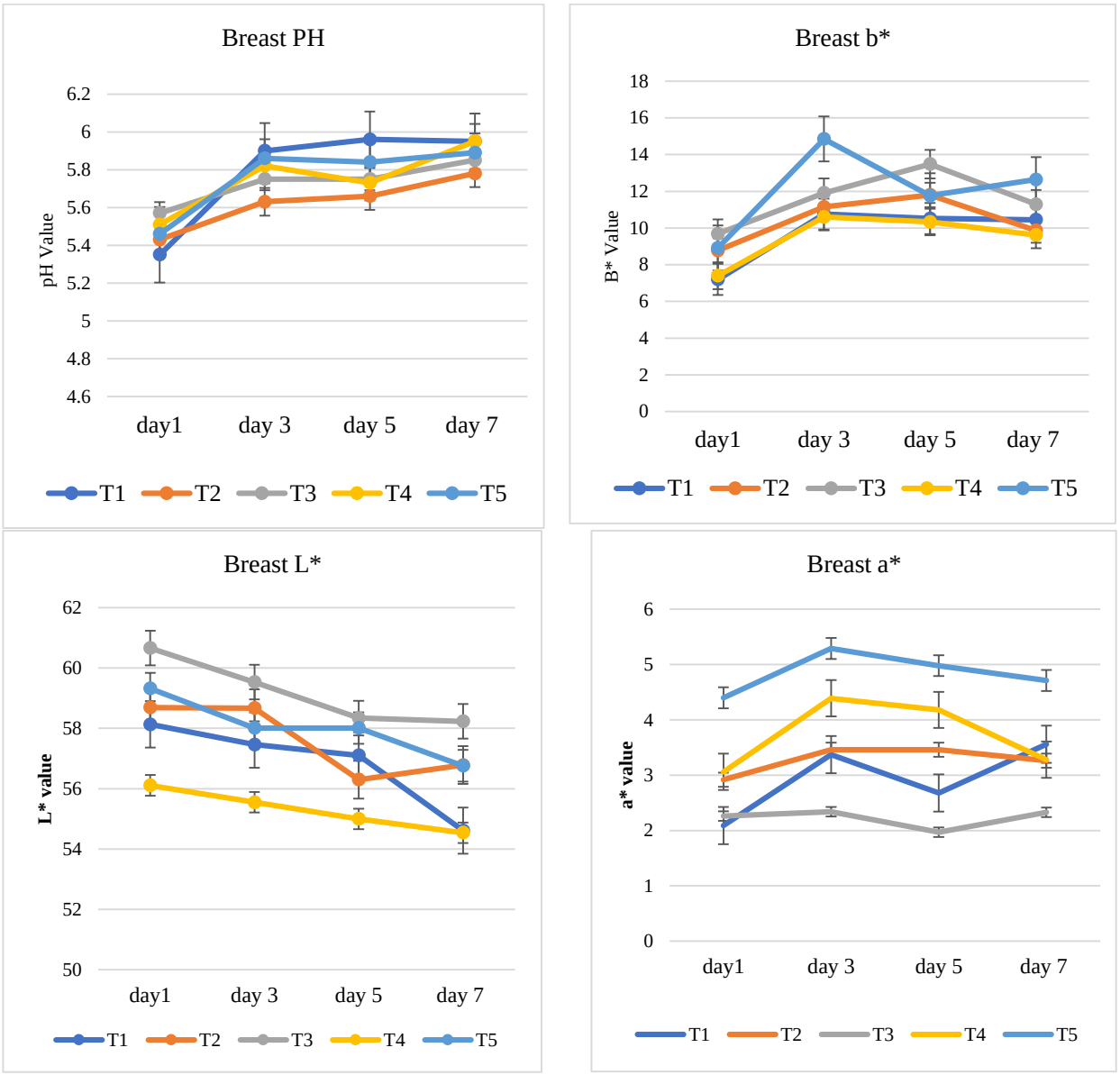
For b* p value for treatments:0.5164, days:<.0001, Treatment* Day:0.1249 and RMSE: 3.69.

For L* p value for treatments:0.6431 days: 0.0635, Treatment* Day:0.5801and RMSE: 6.4.

For a* p value for treatments: 0.7069 days: 0.0002, Treatment* Day: 0.8642and RMSE: 2.38.

T1: Positive control. T2: Negative control. T3: 0.5% OM. T4:1% OM. T5: 1.5% OM

Figure 2: Effect of feeding different levels of OM on meat color and pH of the thigh.



For pH p value for treatments: 0.9103, days: <.0001, Treatment* Day:0.6858and RMSE: 0.379.

For b* p value for treatments: 0.5462, days: <.0001, Treatment* Day: 0.8680and RMSE: 4.26.

For L* p value for treatments: 0.0873 days: 0.0064, Treatment* Day: 0.8670and RMSE: 6.08.

For a* p value for treatments: 0.2155 days: 0.0002, Treatment* Day: 0.9008 and RMSE: 2.18.

T1: Positive control. T2: Negative control. T3: 0.5% OM. T4:1% OM. T5: 1.5% OM

Figure 3: The effect of feeding different levels of OM on breast color and meat pH.

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أثر استخدام نسب مختلفة من مسحوق ورق البردقوش على أداء دجاج اللحم وجودة الذبائح

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ملخص

نتيجة لمنع استخدام المضادات الحيوية ومضادات الكوكسيديا في تغذية الدواجن، تم فتح الباب للبحث عن مصادر طبيعية بديلة لتحسين أداء الحيوانات. يعد نبات البردقوش (Origanum Majorana) من النباتات الزعترية المتواجدة طبيعيا في منطقة الشرق الأوسط والذي يحتوي على العديد من المركبات الثانوية المفيدة لتحسين أداء طيوردجاج اللحم. تم توزيع ثلاث مئة وخمس وسبعون صوص عمر يوم نوع ((Ross 308 على خمس معاملات بثلاثة تكرارات لكل معاملة. كانت المعاملة الأولى معاملة الشاهد حيث احتوى العلف على مضاد الكوكسيديا، أما المعاملة الثانية أخذت علف معاملة الشاهد بدون إضافة مضاد الكوكسيديا، أما المعاملات الثالثة والرابعة والخامسة فقد بني علفها على إضافة مسحوق ورق نبات البردقوش بنسب 1.5, 1، 0.5% على علف المجموعة الثانية. تم تربية القطيع لمدة خمسة وثلاثون يوما، حيث كانت تُسجل مؤشرات أداء الطيور بشكل اسبوعي طوال فترة التجربة. في نهاية فترة التجربة تم ذبح أربعة طيور من كل تكرار ووزنها ثم تم تقطيعها لقياس جودة الذبائح، وأُخذت أوزان القطع بعد أربعة وعشرون ساعة. تم أخذ الصدر والفخذ كعينات من كل مكرر وتم وضعهم في ثلاجة على درجة حراة خمسة مئوية لمدة سبعة أيام. في خلال فترة الحفظ تم قياس لون ودرجة الحموضة للحم في اليوم الأول والثالث والخامس والسابع من بداية فترة الحفظ. أظهرت النتائج أن استخدام مسحوق ورق البردقوش بنسبة نصف بالمئة أدى الى رفع كمية العلف الكلي المأكول بشكل معنوي لدى الطيور (3920) غرام / طير، كما وسَجلت هذه المجموعة أعلى وزن نهائي للطيور بفرق معنوي حيث كان وزن الطير الواحد 2630.15 غرام. بالنسبة لمعامل التحويل وخلال فترة التربية أظهرت النتائج أن أقل قيمة كانت للمجموعة الرابعة حيث كانت القيم 1.34، 1.33، و1.51 للأسابيع الثالث والرابع والخامس على التوالي. لم تُظهر النتائج أي فرق معنوي بين المعاملات في قيم a*،b* * ودرجة الحموضة لقطعة الصدر طوال فترة التخزين، لكن هناك توجه لوجود فرق معنوي(P=0.0873) في شدة اللمعان في لحم الصدر عند استخدام نصف بالمائة من مسحوق ورق البردقوش (L* = 59.19). بالنسبة لقطعة الفخذ لا يوجد أي فرق معنوي في قيم اللون ودرجة الحموضة. أظهرت النتائج ان هناك انخفاض في شدة لمعان اللحم خلال فترة التخزين لكل من الصدر والفخذ لدى جميع المعاملات، وأن هناك زيادة معنوية في درجة الحموضة وقيم b*، a* خلال فترة التخزين. إن استخدام مسحوق ورق البردقوش يؤدي إلى تَحسن في أداء دجاج اللحم وإمكانية تحسين جودة اللحم عند استخدامه كبديل للمضادات الحيوية ولمضاد الكوكسيديا في علائق دجاج اللحم.

الكلمات الدالة: أوريجانوم ماجورانا، دجاج التسمين، الأداء، جودة اللحوم