



## The effect of rosemary (*Salvia rosmarinus*) supplemented diet on squab meat characteristics of Libyan local pigeon

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### Abstract

This study was conducted in the animal house of animal production department, Omar Al-Mukhtar University, Albayda, Libya, to investigate the effect of rosemary (*Salvia rosmarinus*) dried leaves supplemented diet on the nutritional composition of meat and carcass characteristics of local pigeon squab. Thirty pigeon pairs were randomly assigned to three diets in complete randomized design: control (C: 0% rosemary) and two treatment groups (T1: 0.5% and T2: 1% rosemary), with 10 replicates per group. The study lasted from mating until the weaning of hatched squabs. At weaning age, six squabs were randomly chosen (two per group) to study meat characteristics. The rosemary tends to increase live weight and increase the dressing percentage of squab carcasses; this increase was significant with a 0.5% supplement in comparison with C group ( $p < 0.05\%$ ). Except for a decrease in meat to bone ratio in the 0.5% group, the rosemary supplement had no effect on the percentage of primal cuts and meat to bone ratio of these cuts ( $p > 0.05$ ). Rosemary supplement led to a decrease in crop and liver relative weights, while heart weight was not affected ( $p < 0.05$ ). Meat content of proteins, fat, or moisture was not affected by supplement; however, only ash content increased in meat with the increase of supplement from 0.5% to 1% of diet ( $p < 0.05$ ). In conclusion, the rosemary supplement did not affect meat characteristics investigated in this study.

**Key words:** Rosemary, Libyan local pigeon, meat characteristics.

### 1. Introduction

Excavations at Gorham's cave, Gibraltar, proved that Neanderthals used pigeons as food for a period of over 40,000 years (Blasco et al. 2014). The domestication of rock pigeon (*Columba livia*) could have happened later in the Middle East or Mediterranean regions for about 5000 years ago (Price, 2002; Shapiro and Domyan, 2013). Libyan local pigeon belongs to the rock pigeon (*Columba livia*), native to North Africa (Shapiro and Domyan, 2013). Reproductive and productive performance, carcass characteristics and meat nutritional values of local Libyan pigeons has been previously described (Akraim and Jadallah 2021, Akraim et al. 2022, Soltan and Akraim 2023). Domesticated pigeons are bred for the production of sport pigeons, ornamental pigeons, and utility (meat) pigeons (Fekete et al., 1999). Nowadays, pigeon meat is popular in Egypt (Omar et al. 2017), Italy (Dal Bosco et al. 2005), China (Jiang et al. 2019), the United Kingdom, and France (Pomianowski et al. 2009).

In addition to the delicious taste of squab meat, the low cholesterol content makes pigeon meat one of the types of meat that can be consumed without restriction (Buculei et al. 2010). China is the largest producer of pigeon meat (Jiang et al. 2019). Traditional pigeon



nutrition is based on whole-grain feeding. However, recent studies found that complete feed granulated formula was beneficial to squab and should be suggested in practice (Zhang et al. 2022). For several decades, animal feed has been supplemented with diverse feed additives that prove to improve animal performance and health. Aromatic plants and their derivatives have been used as feed additives in poultry nutrition as an alternative to antibiotics due to their ability to enhance feed efficiency, immune system performance, and increase antioxidant capacity (Jin et al., 2020, Abdelli et al., 2021, Kairalla et al., 2022a, 2022b, 2023).

The inclusion of rosemary (*Salvia rosmarinus*) to animal feed is widely practiced and reported to enhance productive performance (Ghazalah and Ali, 2008; Sarmad et al., 2020) and oxidative status (Yesilbag et al. 2011; Ghozlan et al. 2017), but did not affect carcass characteristics (Petricevic et al. 2018; Ghazalah and Ali, 2008) in poultry species. Dal Bosco et al. (2005) reported that the lipid oxidation level in squab carcasses after 90 days of freezing was lower in pigeons in the rosemary supplemented group. Akraim et al. (2022) reported that a rosemary-supplemented diet increased squab performance but negatively affected the reproductive performance of parent pigeons. However, to our knowledge, the effect of rosemary as a feed additive on the carcass characteristics of squabs has not been reported before.

The objective of the current study was to investigate the effect of a rosemary dietary supplement on the nutritional composition of meat and carcass characteristics of local pigeon squab.

## 2. Materials and methods

The study was conducted in Animal house of animal production department, Omar Al-Mukhtar University, Albayda, Libya. Housing, management, and the experimental rosemary plant preparation were previously described (Akraim et al. 2022). Thirty pigeon pairs of local Libyan pigeon were randomly assigned to three dietary treatments: control (C) and two treatment groups (T1 and T2), with 10 replicates per group. All groups received isonitrogenous and isocaloric standard diet (Table 1.).

The control group received the standard diet only, while T1 and T2 groups received the standard diet supplemented with 0.5% or 1% powdered rosemary leaves, respectively. The duration of the experiment was for a complete breeding cycle (from mating to squab weaning).

**Table 1. Ingredients and chemical composition of diet.**

Ingredients	%
Corn grain	66
Wheat grain	10.5
Soybean meal	18.6
Dicalcium phosphate	1.2
Calcium carbonate	2.4
Salt	0.3
Vitamin-mineral mix*	1.0
<b>Chemical composition</b>	
Dry matter	88
Crude protein	15.5
Crude fiber	2.71
Ether extract	3.88
Ash	1.00
Soluble carbohydrates	76.91
ME** (MJ/kg diet)	13.36

\*Vitamin-mineral mix compose of (kg) : Vit A, 1000000 IU, D<sub>3</sub> 300000 IU, E 5000 mg, B<sub>1</sub> 500 mg, B<sub>2</sub> 400 mg, B<sub>6</sub> 400 mg, B<sub>12</sub> 2 mg, K<sub>3</sub> 12.5 mg, C 2500 mg, Nicotinic acid 1500 mg, Calcium pantothenate 2000 mg, Choline chloride 25000 mg, Methionine 3500 mg, Lysine 10000 mg, NaCl 9800 mg, Mg 3000 mg, Mn 3150 mg, Zn 5100 mg, Fe 3100 mg, Cu 250 mg, Co 247 mg, I 137.6 mg, Dical. Phosphate 68300 mg.

\*\* Estimated from the sum of ingredients ME.

### 2 . 1 Slaughtering:

At the end of the experiment, 6 squabs at the age of weaning were randomly chosen (2 from each group). They were fasted for 12 hours, and then the live weight was recorded. The birds were slaughtered by *halal* neck cut (Alshelmai et al., 2016) according to local practice and permitted to thoroughly bleed. Scalding was done in hot water (85 C°) immediately after bleeding. The birds were defeathered, eviscerated, legs and head removed, and the carcasses were weighed (hot carcass weight) for an estimation of dressing percentage. The carcass was cut up into primal cuts (breast, leg, back, and wing), and the weight of these primal cuts and the internal organs (liver, heart, and crop) were recorded. The breast and leg were considered the most valuable cuts.

### 2 . 2 Meat to-Bone Ratio:

This was carried out on every primal cut. Each of them was boiled for 20 minutes, and the flesh, including the skin, was separated from the bones and weighed. Estimations of parameters were carried out as follows:

- Dressing percentage = hot carcass wt/live wt \* 100
- Cut percentage = cut wt/carcass wt \* 100
- Meat-to-bone ratio = wt of meat in the cut/wt of bones in the cut.



### 2 . 3 Chemical analysis:

Chemical analysis for crude protein, crude fat, ash, and moisture was carried out on selected raw meat primal cuts (thigh and breast) according to the methods described by the AOAC (2000).

### 2 . 4 Statistical analysis:

The experiment was designed according to the following model:

Mean of measured trait= general mean + rosemary effect +SE

The data was subjected to one-way analysis of variance, and the means were compared by the LSD test at  $p < 0.05$ . Analysis was done using Systat software (SYSTAT 13 © Copyright 2009, Systat Software, Inc.).

## 3. Results and Discussion

### 3 . 1 The effect of rosemary supplement on the carcass traits:

The effect of rosemary on carcass traits is presented in Table 2. The rosemary supplement increased the dressing percentage of squab carcasses; this increase was significant with a 0.5% supplement of the pigeon's diet in comparison with the control ( $p < 0.05\%$ ). Contrary to our findings, the addition of rosemary to the diet did not increase the dressing percentage of broiler carcasses (Ghazalah and Ali 2008) or rabbit carcasses (El-Gogary et al. 2018). The addition of rosemary led to an increase in the weight of the squabs at weaning (Akraim et al., 2022), which may explain the increased dressing percentage in the squabs of the treatment groups in our study. This hypothesis is supported by Kirton et al. (1984), who found that dressing percentage increases with an increase in live weight. In this study, the percentage of primal cuts in squab carcasses was not affected by the rosemary supplement. The inclusion of rosemary in the diet did not lead to changes in the meat to bone ratio, except for the decrease in the meat to bone ratio in the breast cut of the 0.5% group ( $p < 0.05$ ).

**Table 2. The effect of rosmary supplement on some carcass traits of Libyan local pigeon.**

	C	T1	T2
Live weight (g)	2275.67	288.4	286.1
Dressing percentage (%)	68.82 <sup>a</sup> ± 3.14	77.71 <sup>b</sup> ± 5.34	73.35 <sup>ab</sup> ± 0.72
<b>Primal cuts (% of carcass)</b>			
Legs	11.96 ± 0.13	10.65 ± 1.61	11.80 ± 0.08
Breast	35.69 ± 2.55	33.79 ± 7.04	35.40 ± 4.35
Wings	19.11 ± 0.06	18.74 ± 2.55	20.01 ± 1.25
<b>Meat to bone ratio</b>			
Legs	4.72 ± 0.41	3.93 ± 0.32	4.76 ± 0.38
Breast	11.79 <sup>a</sup> ± 0.87	6.49 <sup>b</sup> ± 0.62	10.38 <sup>a</sup> ± 0.63
Wings	2.06 ± 0.24	1.89 ± 0.14	2.36 ± 0.26

a,b Means with different superscripts in the same row differ significantly ( $p < 0.05$ ).



To our knowledge, there have been no previous studies on the effect of a rosemary supplement on the primal cuts of pigeon carcasses. Petricevic et al. (2018) reported that broiler dressing, drumsticks, thighs, and wings percentages were not affected by the inclusion of rosemary in the diet.

### 3 . 2 The effect of rosemary supplement on the relative weight of some internal organs:

The results for the effects of dietary supplementation with rosemary on some internal organ weights of pigeons are presented in Table 3. Adding rosemary to the diet of pigeons reduced crop and liver weight while having no effect on heart weight ( $p < 0.05$ ). Similarly, the heart relative weight of broilers was not affected by the rosemary supplement (Ghazalah and Ali 2008, Rostami et al., 2015). However, studies on different poultry species did not find any effect on the liver and crop relative weights of a rosemary supplemented diet (Hernandez et al., 2004; Rostami et al., 2015; Soltani et al., 2016; Sarmad et al., 2020).

**Table 3. The effect of rosemary supplement on pigeon's internal organs relative weight (% of carcass).**

	C	T1	T2
Crop	4.57 <sup>a</sup> ± 0.52	2.68 <sup>b</sup> ± 0.32	2.82 <sup>b</sup> ± 0.40
Liver	4.18 <sup>a</sup> ± 0.63	3.34 <sup>b</sup> ± 0.67	2.93 <sup>b</sup> ± 0.41
Heart	1.91 ± 0.27	1.95 ± 0.33	2.09 ± 0.20

<sup>a,b</sup> Means with different superscripts in the same row differ significantly ( $p < 0.05$ ).

Variation between these studies may be related to differences in the parts used of rosemary (meal, leaves, extract, oil), and the active compounds (phenolics) in a unit of weight or volume may vary between studies (Yildirim et al. 2018). Some of the active plant-derived compounds in feed additives may hinder fatty acids synthesis in the liver, reducing the accumulation of fat, and this may lead to a decrease in liver relative weight (Ibraheim et al., 2004: cited by Harrison, 2018).

### 3 . 3 The effect of rosemary supplement on the chemical composition of meat

The results for the effects of dietary supplementation with rosemary on pigeon meat chemical composition are presented in Table 4. The rosemary supplement in this study did not affect the protein, fat, or moisture content of pigeon meat.

**Table 4. The effect of rosemary supplement on pigeon meat chemical composition (%).**

	C	T1	T2
Moisture	63.59 ± 10.46	66.65 ± 4.64	70.80 ± 3.39
Fat	8.59 ± 2.26	8.58 ± 1.23	9.16 ± 1.02
Protein	21.45 ± 1.03	22.02 ± 0.25	21.70 ± 0.70
Ash	1.00 <sup>b</sup> ± 0.04	1.15 <sup>b</sup> ± 0.11	1.35 <sup>a</sup> ± 0.09

<sup>a,b</sup> Means with different superscripts in the same row differ significantly ( $p < 0.05$ ).

However, only the ash content increased in pigeon meat with the increase of the supplement from 0.5% to 1% of the diet ( $p < 0.05$ ).

This is in agreement with the result of Dal Bosco et al. (2005), who reported that rosemary supplement did not affect the chemical composition of pigeon meat.

## Conclusion

The rosemary supplement tends to increased live weight and increased dressing percentage and did not negatively affect carcass traits or the nutritional value of pigeon squab meat.

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## تأثير إضافة اكليل الجبل (*Salvia Rosmarinus*) للعليقة على صفات لحم فراخ الحمام المحلي

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### الملخص

أجريت الدراسة في حظيرة قسم الإنتاج الحيواني بكلية الزراعة، جامعة عمر المختار. تهدف الدراسة إلى معرفة تأثير إضافة مسحوق أوراق إكليل الجبل (*Salvia rosmarinus*) المجففة إلى العليقة على صفات الذبيحة والقيمة الغذائية للحم فراخ الحمام المحلي. تم توزيع ثلاثين زوج من الحمام المحلي عشوائيا على ثلاث علائق في تصميم كامل العشوائية: عليقة شاهد (C: 0% اكليل) وعليقة معاملة أولى (T1: 0.5% اكليل) وعليقة معاملة ثانية (T2: 1% اكليل) مع 10 مكررات لكل مجموعة. استمرت الدراسة من التزاوج وحتى فطام الفراخ الناتجة. تم اختيار 6 فراخ عشوائيا عند عمر الفطام (إثنين من كل مجموعة) لدراسة صفات اللحم. تميل إضافة الإكليل إلى زيادة الوزن الحي وأدت إلى زيادة نسبة النضافي في ذبائح الفراخ، هذه الزيادة كانت معنوية في المعاملة الاولى مقارنة بمجموعة الشاهد ( $p < 0.05$ ). باستثناء انخفاض في نسبة اللحم إلى العظم في المعاملة الاولى، فإن إضافة الإكليل لم تؤثر على نسب القطيعات الاساسية او نسب اللحم إلى العظم فيها ( $p > 0.05$ ). إضافة الإكليل أدت إلى إنخفاض في الأوزان النسبية للكبد والحوصلة بينما لم يتأثر وزن القلب ( $p < 0.05$ ). لم يتأثر محتوى اللحم من البروتين والدهن والرطوبة بإضافة الإكليل للعليقة، بينما زاد محتوى اللحم من الرماد بزيادة اضافة الاكليل للعليقة من 0.5% إلى 1% ( $p < 0.05$ ). نستنتج من هذا البحث أن إضافة إكليل الجبل لعلائق الحمام لا تؤثر على صفات اللحم المدروسة.

كلمات مفتاحية: إكليل، حمام محلي، صفات اللحم.