THE EFFECT OF ADDING FERMENTED OLIVE CAKE WITH AND WITHOUT HERBAL AROMATIC PLANTS TO BROILERS CHICKEN DIET

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SUMMARY

The increased demand for animal products worldwide has led to a rise in the need for feed components. Nonetheless, there was always a need for feed ingredients due to the decrease in farmed land and natural resources. Therefore, researchers are particularly interested in studies on sustainable alternative feed additives. By-products of the olive industry, which could be substituted for other substances in animal and poultry feed, are among the main pollutants that the industry releases into the environment. The by-products of producing olive oil, especially olive cake, are not commonly utilized as feed ingredients for chickens. Even if they are low in nutrients, they could be used after the fermentation process that produce higher-quality nutrients. A total number of 5490 one-day-old unisex Saso chicks, were housed in a deep litter floor under a closed system house, including 3 different treatments with 5 pens (replicates) of 366 chicks in each. Three different feed combinations, were fed. The first group without olive cake representing the control, second group with 10% olive cake (OC) without herbal mixture, and third group with 10% olive cake and 4% herbal mixture. Live body weight (LBW), body weight gain (BWG), and feed conversion ratio (FCR) were all significantly impacted by the olive cake supplement. When OC was added to the diet, triglycerides and cholesterol of blood were considerably reduced in comparison to the control group. Conversely, OC supplementation raised the levels of lipid metabolites (P > 0.05) except for LDL. In conclusion, adding fermented olive cake to the feed won’t have a detrimental impact on the birds’ ability to grow. This study shows that using leftover olive cake in poultry feed affects growth.

Keywords: - Saso, Olive cake, herbs, growth, feed utilization, blood

INTRODUCTION

Poultry is one of the most common livestock species in animal husbandry, with chickens being one of the most popularly consumed (Agyare et al., 2018). Globally, the chicken industry produces more than 9 trillion kilograms of chicken meat annually (Agyare et al., 2018). Current and future projections show that the poultry industry continuously expanding in meat production (OECD/FAO, 2020) with the need to meet the protein demand of the ever-growing human population. To meet this increasing demand, the livestock feed supply is estimated to increase from 6.0 to 7.3 billion tonnes of DM (Kim et al., 2019).

The cost of feeding makes up roughly 70% of the entire cost of producing chickens. Feed supplies are few in developing nations, and the issue grew more complex with the usage of grains and oilseeds for the manufacture of ethanol and biodiesel, respectively. To reduce the overall cost of chicken production, novel, unconventional, low-cost feedstuffs must be found (El-Ghamry & Fadel 2004; Molina-Alcaide & Yanez-Ruiz 2008; Al-Harthi et al., 2011).

Agricultural and food-industry residues constitute a major proportion (almost 30%) of worldwide agricultural production. These wastes mainly comprise lignocellulosic materials, fruit and vegetable wastes, sugar-industry wastes as well as animal and fisheries refuse and by-products. Olive Cake (OC) is the solid residue obtained after olive oil extraction (Sensöz et al., 2006). The utilization of OC as an animal feed is undoubtedly a good way of recycling this by-product. However, the biochemical composition of olive cakes was studied. OC contains a high number of insoluble fibers such as lignin, cellulose, and hemicellulose that renders it unpalatable and poorly digestible. Due to their high fiber content and low digestion, the use of crop wastes and by-products as replacements for cereal and soybean meals proved unsuccessful in the past. To help with fiber digestion (carbohydrases) or solubilize phytic phosphorus...
(phytase), exogenous enzymes can be introduced to broiler diets that contain these by-products, hence lessening the detrimental impact on broiler performance (Choct, 2006). Making animal feed out of the leftovers from the olive oil industry is one method to profit from it. Research has demonstrated that adding up to 150 g/kg of by-products, like cake and olive pomace, to grill diet does not negatively impact the performance of broilers (El Hachemi et al., 2007; Sayehban et al., 2016).

This study focuses on the possible bioconversion of The OC Via solid-state fermentation through microbial fermentation of the olive cake. As known, fermentation is a metabolic process that produces chemical changes in organic substrates through the action of enzymes. In this research, OC is used as an organic substrate for microbial fermentation using solid-state fermentation (SSF), there are many challenges in the bioconversion of the OC.

The current study's goal is to find out what happens when starting feed for the Saso breed including fermented olive cake (FOC) besides, examining the impact of introducing a mixture of herbal and aromatic plants on growth performance, and blood parameters.

MATERIALS AND METHODS

Animal housing and handling procedures were approved by the Institutional Animal Care and Use Committee (CU-IACUC), Cairo University, Egypt, with approval number CU-II-F-43-22, in November 2022.

Diet, design, and birds:

The experiment aimed to study the utilization of fermented olive cake (FOC) as a non-traditional feedstuff in broilers. A total number of 5490 one-day-old unisex Saso chicks, were housed in a deep litter floor under a closed system house in Sekem Belbis, Sharkia governorate, Egypt. The experiment include three different treatments as presented in Table (1) with 5 replicates of 366 chicks in each.

Table (1): Experimental design of the growing experiment.

<table>
<thead>
<tr>
<th>Group</th>
<th>Dietary treatment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control</td>
<td>Without additives</td>
</tr>
<tr>
<td>(Treatment 1)</td>
<td>10 % of FOC without herbal mixture.</td>
</tr>
<tr>
<td>(Treatment 2)</td>
<td>10 % of FOC with 4% herbal mixture.</td>
</tr>
</tbody>
</table>

Diets were created based on the crude protein CP and ME results from the chemical and biological analysis of soybean and corn. Diets were designed to meet the nutrient requirements of Saso chicks using the 2014 Saso Broiler Nutrition Specifications during the starting (1-38 d) period (Table 2).

Herbal and aromatic plants:

The herbal and aromatic plants were obtained from SEKEM Company (Agricultural Seeds, Herbs and Plants Mixed Spices, Belbis, Sharkia governorate, Egypt). Three species of aromatic herbs were used in this study including Lemongrass, Chamomile, and Ment, they were mixed and added at 4% level to treatment 2 as feed additives.

Solid-state fermentation:

The goal of this study was to bio-transform and valorize the by-product of the Egyptian olive industry, olive cake, using the solid-state fermentation process to provide chicken feed with additional value. The difficulty in this situation is getting the complex fibers in the olive cake—lignin, cellulose, and hemicellulose—to become more digestible for birds.

Feed and water were available to all chicks for the duration of the 39-day trial. For the first week, the temperature was adjusted to a maximum of 30°C and a minimum of 2°C per week. After that, the temperature was kept at 24°C. Relative humidity was around 60% to 70% throughout the first week of life; during the second week and until the end of the experiment, it had dropped to 50% to 60%. The chicks were exposed to 23 hours of light and 1 hour of darkness during the first week's daylight. Every day between the second week and the experiment's end, birds were exposed to 20 hours of daylight and 4 hours of darkness. In neither of the two tests are there any appreciable variations in the initial body weights of the chicks (P>0.05). The average starting body weight of each chick was 45.00 +/- 1.00 g.
Table (2): Physical and chemical composition (%) of the experimental diets.

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>Experimental Diet</th>
<th>Treatment 1</th>
<th>Treatment 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yellow corn</td>
<td>50.35</td>
<td>41.70</td>
<td>41.70</td>
<td></td>
</tr>
<tr>
<td>Soybean meal ( 44 %)</td>
<td>42.00</td>
<td>41.00</td>
<td>41.00</td>
<td></td>
</tr>
<tr>
<td>Soybean oil</td>
<td>3.65</td>
<td>3.45</td>
<td>3.45</td>
<td></td>
</tr>
<tr>
<td>Olive cake</td>
<td>0.00</td>
<td>10.00</td>
<td>10.00</td>
<td></td>
</tr>
<tr>
<td>Herbal mixture</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
<td></td>
</tr>
<tr>
<td>Calcium carbonate</td>
<td>1.30</td>
<td>1.30</td>
<td>1.30</td>
<td></td>
</tr>
<tr>
<td>Di-calcium phosphate</td>
<td>1.60</td>
<td>1.50</td>
<td>1.50</td>
<td></td>
</tr>
<tr>
<td>Common salt</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>Premix1</td>
<td>0.30</td>
<td>0.30</td>
<td>0.30</td>
<td></td>
</tr>
<tr>
<td>DL- Methionine</td>
<td>0.25</td>
<td>0.20</td>
<td>0.20</td>
<td></td>
</tr>
<tr>
<td>L-Lysine HCl</td>
<td>0.15</td>
<td>0.15</td>
<td>0.15</td>
<td></td>
</tr>
<tr>
<td>Toxenil</td>
<td>0.10</td>
<td>0.10</td>
<td>0.10</td>
<td></td>
</tr>
<tr>
<td>Chemical composition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>GE, Kcal/Kg</td>
<td>3204.83</td>
<td>3202.33</td>
<td>3204.436</td>
<td></td>
</tr>
<tr>
<td>CP, %</td>
<td>22.508</td>
<td>22.276</td>
<td>22.276</td>
<td></td>
</tr>
<tr>
<td>EE, %</td>
<td>6.138</td>
<td>6.0326</td>
<td>5.376</td>
<td></td>
</tr>
<tr>
<td>CF, %</td>
<td>2.411</td>
<td>2.3988</td>
<td>2.3689</td>
<td></td>
</tr>
<tr>
<td>Ca, %</td>
<td>1.202</td>
<td>1.198</td>
<td>1.1378</td>
<td></td>
</tr>
<tr>
<td>Available phosphorus, %</td>
<td>0.464</td>
<td>0.458</td>
<td>0.4307</td>
<td></td>
</tr>
<tr>
<td>Lysine, %</td>
<td>1.293</td>
<td>1.0949</td>
<td>1.0119</td>
<td></td>
</tr>
<tr>
<td>Methionine, %</td>
<td>0.651</td>
<td>0.5487</td>
<td>0.5352</td>
<td></td>
</tr>
</tbody>
</table>

**Measurements and methods of interpreting results:**

According to North (1984), chick's performance response variables were established; weekly individual live weight (LBW) and body weight gain (BWG) measurements were made. For each replicate, feed conversion ratio (FCR) (g feed/g live BWG), mortality rate (MR%), and weekly feed intake (FI) (g/d/bird) were measured.

The weight of each chick was measured to the closest gram. On the first day of life and subsequently every week until the experiment's conclusion, each subject's body weight was noted. Body weight gain was estimated by deducting the final body weight at the same period from the average initial body weight during the relevant period.

The feed intake (FI) of each replicate was recorded weekly until the end of the experiment as follows:

- Average feed intake/chick = feed intake in grams per week divided by the number of chicks during the same week.

Feed conversion ratio (FCR) was calculated weekly for each group, including the weight gain of the dead birds as follows:

- FCR = feed intake in grams divided by body weight gain in grams.
- European Production efficiency index (EPEI)= LBW(kg) X %survival rate) X 100 / Feed conversation X duration of experiment.

Every day during the experiment, the mortality rate (MR%) was noted and calculated for each replicate at the end of each experimental period. Additionally, a cumulative mortality calculation was made.

Using commercial diagnostic kits, the following blood plasma lipid profiles were measured: total cholesterol (Watson 1960), low-density lipoprotein (LDL) (Wieland & Seidel 1983), high-density lipoprotein (HDL) (Lopez-Virella et al., 1977), and triglycerides (Fossati & Prencipe 1982).

**Statistical analysis:**

SAS software's general linear model was used to do a one-way analysis of variance in the data gathered from this experiment (SAS, 2010). The olive cake inclusion level with and without an herbal mixture was
the key determinant. When there were substantial discrepancies, Duncan's New Multiple Range test (Duncan, 1955) was used to compare the means. The analysis's fixed effects model was as follows:

\[ Y_{ij} = \mu + T_i + e_{ij} \]

Where:
- \( Y_{ij} \): the observation of the \( j \)th chick in the \( i \)th treatment.
- \( \mu \): the overall mean.
- \( T_i \): effect of the \( i \)th treatment (\( i = 1, 2, 3, \)).
- \( e_{ij} \): the experimental random error effect.

The significance level was set at (\( \alpha = 0.05 \)).

RESULTS AND DISCUSSION

Productive performance:

The data for the broiler chickens' growth, survival rate, feed intake, FCR, and EPEI between 1-38 days of age are presented in Tables 3 and 4. There were no discernible changes in the chicks' initial body weights among treatments supported their random distribution. It was noted that the FOC level added to the broiler feed had no appreciable impact on the BWG between 1-38 days of age, feed intake, FCR, or EPEI.

The results indicated the presence of differences in body weight and body weight gain among experimental groups. Body weight and body weight gain of the group that fed a 10% OC diet with an herbal mixture were significantly higher at 38d of age compared to the other experimental groups and the control. However, both the control and treatment 1 (OC without herbal mixture) experimental groups were nearly similar in survival rate without significant differences.

Table 3: Effect of experimental diet on live body weight, body weight gain, and survival rate of broiler chickens during the period from 1 to 38 d of age.

<table>
<thead>
<tr>
<th>Item</th>
<th>Control</th>
<th>Treatment 1</th>
<th>Treatment 2</th>
<th>SEM</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Initial BW, g</td>
<td>42</td>
<td>45</td>
<td>48</td>
<td>1.87</td>
<td>0.956</td>
</tr>
<tr>
<td>Final BW 38 d of age, g</td>
<td>1044</td>
<td>1087</td>
<td>1154</td>
<td>21.24</td>
<td>0.237</td>
</tr>
<tr>
<td>BWG 1 to 38 d of age, g</td>
<td>1002(^c)</td>
<td>1042(^b)</td>
<td>1106(^a)</td>
<td>17.46</td>
<td>0.005</td>
</tr>
<tr>
<td>Survival rate 1 to 38 d of age, %</td>
<td>60(^b)</td>
<td>65(^b)</td>
<td>80(^a)</td>
<td>1.49</td>
<td>0.009</td>
</tr>
</tbody>
</table>

\(^a-c\) Means with different superscripts within each row are significantly different (\( P<.0001 \)).

The findings show that OC had no detrimental effects on growth, feed intake, or FCR. This result could be explained by the use of isocaloric and isonitrogenous diets. These findings are in line with earlier research (Abo-Omar 2000; Rabayaa 2000; Abo-Omar 2005), which demonstrated that chickens may be fed OC up to 10% without suffering negative effects on growth, feed intake, or FCR. Additionally, it was demonstrated by El Hachemi et al. (2007) and Rupic et al. (1992) that OC may be added to grill chicken feed up to 15% without harming feed intake or feed utilization. However, according to Al-Shanti and Abo-Omar (2003), broiler diets containing OC at 10% considerably increased FCR. Moreover, the incorporation of OC in broiler feeds did not adversely affect the availability of other nutrients, resulting in identical performances being attained. These findings are in line with those published in the literature, which suggests that the impact of FOC depends on the nutrient composition of the diet and the availability of an appropriate substrate (Stavric and Kornegay 1995, Onifade, 1998).

In comparison to the control group (OC-free diet), the results showed that OC at 10%, boosted the survival rate. These findings agree with those made public by Chumpawadee et al. (2008), Hassan et al. (2012), Karaoglu and Durdag (2005).

Table 4 displays the impact of OC addition to broiler diets on feed intake (FI), feed conversion ratio (FCR) and EPEI. The control group had the lowest feed consumption, while those fed 10% FOC consumed more feed without significant differences (\( P=0.156 \)). Furthermore, no variations were seen in feed conversion ratios between the groups and the control group. Similarly, when looking at the European production efficiency index of grill chickens at 38 days of age, there were no changes between the groups (\( P = 0.245 \)). The findings showed that broilers fed OC at a rate of 10% and supplemented with an herbal
mixture at 38 days of age had the best European production index. From the perspective of the productivity index, broiler diets supplemented with up to 15% OC may be advantageous (Al-Harthi, 2017).

Table (4): Effects of experimental diets on feed intake, feed conversion ratio, and European Production Efficiency Index of broiler chickens from 1 to 38 d of age.

<table>
<thead>
<tr>
<th>Item</th>
<th>Experimental diet</th>
<th>Control</th>
<th>Treatment 1</th>
<th>Treatment 2</th>
<th>SEM</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Feed intake (FI), 1 to 38 d of age, g</td>
<td>1513</td>
<td>1600</td>
<td>1530</td>
<td>35.02</td>
<td>0.136</td>
<td></td>
</tr>
<tr>
<td>Feed Conversion ratio (FCR), 1 to 38 d of age, g</td>
<td>1.41</td>
<td>1.44</td>
<td>1.41</td>
<td>0.028</td>
<td>0.203</td>
<td></td>
</tr>
<tr>
<td>European Production Index</td>
<td>267.6</td>
<td>277.4</td>
<td>281.1</td>
<td>18.33</td>
<td>0.245</td>
<td></td>
</tr>
</tbody>
</table>

Blood biochemical parameters:

Table 5 lists the effects on liver, kidney, functions as well as blood biochemical markers after adding 10% fermented olive cake with or without herbal mixture. The outcomes demonstrate how OC affects the total protein in plasma. OC had no discernible impact on plasma total protein. According to Nakagi et al. (2013), these results highlight the liver's capacity to synthesize these proteins, which also demonstrates the effectiveness of the kidney, immune system, and metabolic processes. These findings are consistent with other research (Al-Shanti and Abo-Omar, 2003; Hajati, 2010) which found no detrimental effects of OC inclusion or enzyme addition on most of the blood's biochemical contents in chickens (Al-Shanti and Abo-Omar, 2003; Hajati, 2010; Sateri et al., 2017).

The impact of OC addition on blood lipid components (triglycerides, cholesterol, high-density lipoprotein (HDL), low-density lipoprotein (LDL), and HDL/LDL ratio) is shown by the data in Table 5. Cholesterol and triglycerides were significantly impacted. Triglycerides were considerably greater in chickens on control diets than in those on OC-free diets, even when OC addition was not taken into account. At the OC level, no appreciable variations were found, nevertheless.

The HDL and HDL / LDL of chickens on the control diet (no OC and no enzyme supplementation) were lower than those of groups on a similar diet that included 10% OC.

Table (5): Effect of experimental diets on blood biochemical parameters.

<table>
<thead>
<tr>
<th>Item</th>
<th>Experimental diet</th>
<th>Control</th>
<th>Treatment 1</th>
<th>Treatment 2</th>
<th>SEM</th>
<th>P-Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Protein, g/dl</td>
<td>3.26</td>
<td>3.30</td>
<td>2.90</td>
<td>0.15</td>
<td>0.1670</td>
<td></td>
</tr>
<tr>
<td>Triglycerides, mg/dl</td>
<td>162.66 a</td>
<td>124.00 b</td>
<td>126.00 b</td>
<td>5.00</td>
<td>(&lt;0.0001)</td>
<td></td>
</tr>
<tr>
<td>Total Cholesterol, mg/dl</td>
<td>150.33 a</td>
<td>128.00 b</td>
<td>125.00 b</td>
<td>6.03</td>
<td>0.0003</td>
<td></td>
</tr>
<tr>
<td>HDL, mg/dl</td>
<td>83.33 b</td>
<td>97.00 a</td>
<td>96.00 a</td>
<td>2.403</td>
<td>0.0531</td>
<td></td>
</tr>
<tr>
<td>LDL, mg/dl</td>
<td>20.00</td>
<td>19.00</td>
<td>18.66</td>
<td>2.09</td>
<td>0.8960</td>
<td></td>
</tr>
<tr>
<td>HDL/LDL ratio</td>
<td>4.16 b</td>
<td>5.10 a</td>
<td>5.14 a</td>
<td>0.57</td>
<td>0.0481</td>
<td></td>
</tr>
</tbody>
</table>

\(a-c\) Means with different superscripts within each row are significantly different (\(P=Ns, P<.0001\)).

CONCLUSION

It is determined that fermented olive cake, when added to a herbal mixture and fed to broilers for up to 10% of their diet during the first 38 days of life, is a valuable and safe element. Additionally, some beneficial impacts were observed in those feds on OC, which led to better growth performance in terms of vitality.

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REFERENCES


تأثير إضافة تقل الزيتون المتخمرة مع وبدون النباتات طبيعية عطرية إلى علائق الدجاج التسمين

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قسم الإنتاج الحيواني - كلية الزراعة. جامعة القاهرة
كلية الزراعة الحيوية - جامعة هليوبوليس لتنمية المستدامة

أدى الطلب المتزايد على المنتجات الحيوانية في جميع أنحاء العالم إلى زيادة الحاجة إلى مكونات الأعلاف. ومع ذلك، كانت هناك دائمًا حاجة إلى مكونات الأعلاف بسبب انخفاض الأراضي الزراعية والموارد الطبيعية. ولذلك، يهم الباحثون بشكل خاص بالدراسات المتعلقة بإضافات الأعلاف البديلة المستدامة. تعتبر المنتجات الثانوية لصناعة الزيتون، والتي يمكن استبدالها بمواد أخرى في أعلاف الحيوانات، من بين المكونات الرئيسية التي تقلل من الطلب من البيئة. لا يتم استخدام المنتجات الثانوية لإنتاج زيت الزيتون، وخاصة تفل الزيتون، بشكل شائع كمكونات علفية للدواجن. وحتى لو كانت منخفضة من الناحية الغذائية، فإنها يمكن استخدامها بعد عملية التخمير التي تنطوي على معالجة مخبرية بسخاء. على الرغم من أن تقل الزيتون لا يمكن استخدامها في أعلاف الدواجن، فكلية الزيتون، خاصة تفل الزيتون، يمكن استخدامها بعد عملية التخمير التي تنطوي على معالجة مخبرية بسخاء. على الرغم من أن تقل الزيتون لا يمكن استخدامها في أعلاف الدواجن، فكلية الزيتون، خاصة تفل الزيتون، يمكن استخدامها بعد عملية التخمير التي تنطوي على معالجة مخبرية بسخاء. على الرغم من أن تقل الزيتون لا يمكن استخدامها في أعلاف الدواجن، فكلية الزيتون، خاصة تفل الزيتون، يمكن استخدامها بعد عملية التخمير التي تنطوي على معالجة مخبرية بسخاء. على الرغم من أن تقل الزيتون لا يمكن استخدامها في أعلاف الدواجن، فكلية الزيتون، خاصة تفل الزيتون، يمكن استخدامها بعد عملية التخمير التي تنطوي على معالجة مخبرية بسخاء. على الرغم من أن تقل الزيتون لا يمكن استخدامها في أعلاف الدواجن، فكلية الزيتون، خاصة تفل الزيتون، يمكن استخدامها بعد عملية التخمير التي تنطوي على معالجة مخبرية بسخاء. على الرغم من أن تقل الزيتون لا يمكن استخدامها في أعلاف الدواجن، فكلية الزيتون، خاصة تفل الزيتون، يمكن استخدامها بعد عملية التخمير التي تنطوي على معالجة مخبرية بسخاء. على الرغم من أن تقل الزيتون لا يمكن استخدامها في أعلاف الدواجن، فكلية الزيتون، خاصة تفل الزيتون، يمكن استخدامها بعد عملية التخمير التي تنطوي على معالجة مخبرية بسخاء. على الرغم من أن تقل الزيتون لا يمكن استخدامها في أعلاف الدواجن، فكلية الزيتون، خاصة تفل الزيتون، يمكن استخدامها بعد عملية التخمير التي تنطوي على معالجة مخبرية بسخاء. على الرغم من أن تقل الزيتون لا يمكن استخدامها في أعلاف الدواجن، فكلية الزيتون، خاصة تفل الزيتون، يمكن استخدامها بعد عملية التخمير التي تنطوي على معالجة مخبرية بسخاء. على الرغم من أن تقل الزيتون لا يمكن استخدامها في أعلاف الدواجن، فكلية الزيتون، خاصة تفل الزيتون، يمكن استخدامها بعد عملية التخمير التي تنطوي على معالجة مخبرية بسخاء. عليه، فإن إضافة تقل الزيتون المتخمرة إلى العلائق لن تكون لها تأثير ضار على قدرة الطيور على النمو.

أظهرت هذه الدراسة أن استخدام تقل الزيتون في أعلاف الدواجن له تأثير على النمو.