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A COMPARATIVE STUDY ON THE EFFECT OF SOME FEED COLORS ON THE PRODUCTIVE AND REPRODUCTIVE PERFORMANCE IN PIGEONS *(COLUMBA LIVIA DOMESTICA)*

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ABSTRACT: The current study was conducted to investigate whether feed coloring red or green, could stimulate pigeons to consume more feed thereby enhancing both productive and reproductive performance. The statistical analysis used in this study was a completely randomized design. A total of 18 adult pairs of pigeons were used at the beginning of the experiment. In this study, the birds used were divided into three experimental basic groups: the control group, the red-colored ration, and then the third group, was fed the green-colored ration. Each treatment had 6 adult pairs for three consecutive nesting cycles. The results indicate that under the condition of this experiment, a significant difference observed in body weight at 4 weeks (BW4) among the experimental groups, with means of 385g for the control group, 406g for the red group, and 355g for the green ration group, Moreover, significant differences were observed in total weight gain, with means of 366, 398, and 341, feed intake with mean values of 90.0, 93.9, and 88.4, and relative feed conversion ratio of 5.72, 4.26, and 5.91 for the control, red-colored ration, and green-colored ration groups, respectively. However, there were no significant effects of red or green rations on egg weight, body weight at hatch, fertility, hatchability, egg-laying cycle, or the period between hatching and the next laying. Based on the results observed from this study, consumption of red-colored food gave better results with regard to productive performance, while there were no effects on reproductive traits in a short time. Further researches are needed to study the effect of more colors in pigeon feeds to determine their impact on both productive and reproductive performance.

Keywords: Pigeon, Feed colors, Productive performance, Reproductive traits.

INTRODUCTION

The domestication of the pigeon (*Columba livia*) back to the Neolithic era, around 6,000 years ago, in the fertile expanse of the Mesopotamian Valley, marking the beginnings of a journey that intertwines with human civilization (Sossinka, 1982; Giunchi *et al.*, 2020). The pigeon production sector includes pigeons raised for meat, racing and ornamental purposes (Gao *et al.*, 2016). The scale of pigeon production sees annual growth, positioning pigeons as the fourth most significant bird in the domestic meat production hierarchy, after chickens, ducks, and geese (Ji *et al.*, 2022). In recent years, China produced more than 111 million pairs of breeding pigeons and sold 1.6 billion squabs (Gao, 2022). Additionally, there has been a significant increase in squab consumption in the United States, Britain, Canada, and France, a trend that is expected to continue (Ji *et al*., 2022; Zhao *et al.*, 2022; Zhong *et al.*, 2022). The existing researches on pigeon production in Egypt are limited and necessitates broader investigation in care, nutrition and genetic improvement (Ahmed *et al.*, 2022; Ahmed, 2023; Adawy and Abdel-Wareth, 2023).

The composition of poultry feed varies in coloration and poultry rations are continually changing due to the diversity of ingredients used (Abu Tabeekh, 2015). It is well verified that birds can see in a wide range of colors and some colors can be stimulatory (Gulizia and Downs, 2021). Some poultry species exhibit an innate preference for selecting feed based on its color (Goldsmith, 2006). Feed intake is an essential factor determining chicken performance, mainly body weight and weight gain (Yang *et al*., 2009) . There are a significant effects of feed color on feed conversion, body weight, body weight gain, feather condition and mortality rate for growing native turkeys (Farghly and Mahrose, 2018). There's a possibility that some feed colors are more attractive to birds, leading them to detect feed more easily and consume more (Cooper, 1971; Khosravinia, 2007; Lecuelle *et al.*, 2010; Ueda *et al.*, 2005; Weeks *et al.*, 1997).

The aim of the current study was to determine whether coloring feed red or green could enhance the productivity of pigeons compared to the control.

MATERIALS AND METHODS

This study was approved by the Animal Care and Ethics Committee of Alexandria University (serial number: 0306667).

LOCATION

The Experiment was Conducted at the Research Poultry Farm of Animal and Poultry Production Department, Faculty of Desert and Environmental Agriculture, Matrouh University, Matrouh, Egypt from October 2023 to February 2024.

EXPERIMENTAL DESIGN

A total number of 18 pairs of adult domestic pigeon at 8 months of age were randomly divided according to its consistent mating system (sex ratio of pigeons 1:1) into three equal groups containing six pairs, to evaluate the effect of feed color on their productive and reproductive performance.

The first group, designated as the control group (C), was provided with a colorless diet. In contrast, the second group (T1) and the third group (T2) were fed diets artificially colored red and green, respectively. The study was carried out over three consecutive nesting cycles.

Coloring agents added to the feeds are safe, artificial colors and commonly used in human food products and supplied by Diamond Company (email: Diamond@diamondeg.com).

BIRDS MANAGEMENT:

Each pair of pigeons was reared individually in numbered metal cage at the same space in opened -house system under hygienic conditions with natural lighting and ventilation. Also, pigeons were individually marked with a leg number. The dimensions of the cages were as follows: 60 cm in length, 60 cm in width, and 50 cm in height. All birds were fed on the same experimental diet *ad libitum* and given free access to water during the whole experimental period.

EXPERIMENTAL DIET

The composition and calculated analysis of the basal experimental diet are presented in Table (1). Pigeons were fed a basal diet had 15.16% protein and 2800Kcal Metabolizable energy (ME)/kg of diet

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STUDIED TRAITS

1- Productive traits

-Live body weight (BW)

Squabs were weighed at hatch (BW0) and at weaning on day 28 of age (BW4) at a fixed time of 10:00 AM to determine the live body weight and recorded to the nearest gram

-Body weight gain (BWG)

The body weight gain of squabs was calculated by subtracting the initial body weight at hatch (BW0) from the final body weight at weaning (BW4).

- Feed intake (FI)

The feed intake was determined at the end of each week as the difference between the amount of feed supplied and the remaining feed for each pair. Each pair was given access to feed on a daily basis. It was calculated that daily feed intake equaled weekly feed consumption /7.

-Feed conversion ratio (FCR)

The feed conversion efficiency was calculated as the ratio between feed intake from hatching to weaning (28 days) and weight gain during the same period, incorporating the weight of the eggs.

2- Reproductive traits

-Egg weight (EW)

Egg weight was recorded at the laying-day using a scale with an accuracy of 0.01 gram.

-Fertility rate (FR)

The fertility rate was determined by candling using a small lamp on the seventh day after laying.

-Hatchability (HR)

Total hatchability percentage (TH%) was determined regarding the total number of produced eggs. While, hatchability of fertile eggs percentage (FH%) was calculated concerning the number of fertilized eggs.

-Egg laying cycle (ELC)

The interval between the laying of fertilized eggs (in days) in consecutive nests was calculated.

- Period between hatching and next laying. (PBHNL)

The intervals between successful hatching and the next laying in days were calculated.

STATISTICAL ANALYSIS

A preliminary analysis was performed using Jamovi 2.2.5 software (The Jamovi project, 2021) to obtain least-squares means. Model 1 Effects of feed color (3 colors) were treated as fixed effect. The model was used;

$Y_{ij} = \mu + T_j + e_{ij}$ (Model)

Also, by the Jamovi program, the Binomial test and Kruskal-Wales analysis were used for fertility, hatchability.

Data were subjected to analysis of variance by Duncan's multiple range test (Duncan 1955).

RESULTS AND DISCUSSION

PRODUCTIVE PERFORMANCE:

Least-squares means of initial body weight (BW0), final body weight at weaning (BW4) and total weight gain (TWG) are presented in Table (2).

The present study showed that there were not significant differences in BW0. However, pigeons received red feed had the highest ($P<0.001$) BW4 and TWG for produced squabs, followed by those fed control feed, but the lowest value ($P<0.001$) was observed for those received green feed.

The mean values for daily feed intake (FI) and feed conversion ratio (FCR) per each pair of pigeons across different experimental feed colors are shown in Table (3).

Results indicated that the highest ($P<0.001$) feed intake was obtained for pigeons received red feed compared to control and green. Also, birds received control feed had significant ($P<0.001$) higher FI compared to those fed on green feed.

Our observations revealed that the best ($P<0.05$) FCR was noticed for parents fed on red feed compared with other groups. Data explained that there were not significant differences between birds fed on green feed and those which received control feed.

There were not previous studies that evaluated the effects of feed color on pigeons are limited, so other poultry types like turkey and broiler were used to assess feed color influences in the current study. Further, much of the feed color research in poultry is not current. The consistencies and inconsistencies between the results of the present study and previous studies are likely due to variations in poultry-fed behavior.

Feed intake has a significant impact on birds performance especially body weight gain with the compensatory growth (Yang *et al.,* 2009). Therefore, increased feed intake by any feeding program can optimize the growth of birds

(Henderson *et al.,* 2008 and Valencia *et al.,* 2009).

Our findings closely matches that of Farghly and Abou-Kassem (2014), who found that feed color had a substantial (P<0.05) impact on feed conversion and consumption in native Egyptian turkeys. Also, the present study in agreement with findings of Farghly and Abdelfattah (2017), who showed that red feed color significantly (P<0.05) improved BW, BWG and FC during the 6th weeks of age for broiler. Farghly (2017) observed that the body weight and body weight gain of birds that were fed red color increased significantly (P<0.05) over those that were fed the non-colored feed group. Additionally, Toghyani and Mesmarian (2018) found that feed consumption was significantly (P<0.01) increased for broilers fed on red feed color compared with control. Also, they added that body weight and FCR were improved (P< 0.05) for birds received red feed color as compared to those fed control feed. Hurnik *et al.,* (1971) found that White Leghorn pullets were stimulated to consume feed by colored feed. According to Leslie *et al.,* (1973), feed coloration may alter feed consumption at different feeding phases. The current observations are uniform with the results obtained by Gulizia and Downs (2021), who examined the effect of feed colors red, green, blue, control, orange, yellow, and purple and obtained that the red color of the feed improved the FCR in broiler chickens.

The current observations of BW, BWG, FI and FCR did not agree with the results of Farghly and Mahrose, (2018), who indicated that the green color of feed was the preferred color of turkeys. Moreover, FCR for broilers was not significant affected by red and green feed color during the period of 3-6 weeks of age (Farghly and Abdelfattah, 2017). As reported by Farghly and Sharara (2016), feed color had no discernible impact on feed consumption and body weight in local turkey. According to research by Farghly and Mahrose (2018), turkey poults fed green feed had slightly greater BW than the other groups. However, they explained that the effects of feed color on the experimental groups' FC and FCR were not statistically different. Bobwhite birds showed a favorable relationship with the color yellow and negative relationships with green and red (Eldridge 2022).

This contrast in the result could be clarified by that there are possible differences in the preference for feed color between different types and breeds of poultry, this probably explanation is supported by the results obtained by (Farghly and Abdelfattah, 2017; Farghly and Mahrose, 2018; Gulizia and Downs, 2021; Lecuelle et al., 2010)

REPRODUCTIVE PERFORMANCE:

As shown in Tables (4 and 5), we can notice that different used feed colors had not any significant effects on egg weight, fertility%, hatchability%, egg-laying cycle, and the period between hatching and next laying (PBHNL).

Reproductive traits respond with either improvement or decline depending on the changes that occur in care and nutritional factors, Mariey (2013) indicated that there are significant differences in the egg-laying cycle and egg weight in pigeons as a result of differences in nutritional factors, but the possible reason for the lack of significant differences in reproductive traits in current study, despite the presence of differences in feed consumption, may be the short duration of the current experiment and the response of reproductive traits not quickly like growth traits.

CONCLOUSION

Red feed color was found to positively influence feed intake, feed conversion, body weight at four weeks, and body weight gain more than green and control feed. However, there are no significant effects on reproductive traits in the current study period.

Table (1): Composition and calculated analysis of the basal experimental diet

Ingredients	(%)
Yellow Corn	19.64
Beans	19.64
Sorghum grain	47.15
Dried Green Peas	9.82
Safflower seeds	0.98
*Premix	0.59
NaCl	0.20
Grit	1.98
Total	100
Calculated analysis**	
CP%	15.16
ME (Kcal)	2800
Crude Fiber (%)	4.00
Ether extract (%)	3.30
Calcium (%)	1.20
Phosphorus available (%)	0.58
Arginin%	0.89
Methionine (%)	0.51
Lysine (%)	0.67

*Each kg of vitamin and mineral mixture contains: 12 M IU vitamin A ; 5 M IU D3 ; 80000 mg E ; 4000 K mg ; 4000 mg B1 ; 9000 mg B2; 4000 mg B6 ; 20 mg B12 ; 15000 mg pantothenic acid ; 60000 mg Nicotinic acid ; 2000 mg Folic acid ; 150 mg Biotin ; 400000 mg Choline Chloride ; 15000 mg Copper sulphate ; 1000 mg calcium Iodide ; 40000 mg ferrous sulphate ; 100000 mg Manganese oxide ; 100000 mg Zinc oxide and 300 mg Selenium selenite.
**Calculated values were according to NRC (1994).

Table (2): Least-squares means (± standard error) for live body weight, weight gain and growth rate

Feed color	BW0 (per squab)	BW4 (per squab)	Total Weight gain (per squab)
Control	19.9 ±0.69	385 ±4.4^{b}	366 ±7.7^{b}
Red	18.5 ±0.66	406 ±4.2^{a}	398 ±4.5^{a}
Green	17.8 ±0.69	355 ±4.7^{c}	341 ±7.7^{c}
P value	0.187	<0 .001	0.003

BW0: live body weight at hatch, BW4: live body weight at 4 weeks.

Table (3): Least-squares means (± standard error) for feed intake and relative feed conversion.

Feed color	Feed intake/g/pair/day	FCR
Control	90.0 ±0.35^{b}	5.72 ±0.78^{b}
Red	93.9±0.34^{a}	4.26 ±0.74^{a}
Green	88.4 ±0.34^{c}	5.91 ±0.78^{b}
P value	<0 .001	0.027

FCR: Relative feed conversion.

Table (4): Least-squares means (± standard error) for egg weight, fertility and hatchability.

Feed color	Egg weight	Fertility%	Total hatchability %	Hatchability in fertile egg %
Control	18.5 ±0.60	90.9 ±0.06	75.00 ±0.09	88.2 ±0.08
Red	17.9 ±0.54	92.6 ±0.05	77.8 ±0.08	91.7 ±0.05
Green	18.4 ±0.52	87.5 ±0.07	81.5 ±0.06	89.00 ±0.08
P value	0. 658	0.407	0.459	0.562

Table (5): Least-squares means (± standard error) for egg laying cycle and period between hatching and next laying.

Feed color	Egg laying cycle (days)	PBHNL (days)
Control	43.0±2.44	26.0±2.32
Red	46.9±2.57	29.2±1.78
Green	45.2±2.15	26.8±1.86
P value	0.074	0.700

PBHNL: period between hatching and next laying.

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الملخص العربي

دراسة مقارنة على تأثير بعض ألوان العلف على الأداء الإنتاجي والتناسلى فى الحمام (COLUMBA LIVIA DOMESTICA)

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أجريت الدراسة الحالية لتقييم تأثير لون العلف على الأداء الإنتاجي وبعض الصفات التناسلية للحمام. تم التحليل الإحصائي في هذه الدراسة بالتصميم تام العشوائية. تم تقسيم الطيور المستخدمة إلى ثلاث مجموعات تجريبية: أولا طيور مجموعة المقارنة ثانياً الطيور التي غذيت العليقة ذات اللون الأحمر، ثالثاً المجموعة التي غذيت على العليقة ذات اللون الأخضر. في بداية التجربة تم استخدم ١٨ زوجًا بالغًا من الحمام، وتم تقسيمهم على ثلاث مجموعات تحتوي كل مجموعة على ٦ أزواج. وتم اجراء المعاملات لثلاث دورات تعشيش متتالية. أشارت النتائج إلى وجود فروق ذات دلالة إحصائية بين المجموعات وكانت قيم المتوسطات لوزن الجسم عند الفطام ٣٨٥ و ٤٠٦ و ٣٥٥ جرام لمجموعة المقارنة والعلف الملون بالأحمر والعلف الملون بالأخضر بالترتيب علاوة على ذلك، لوحظت فروق ذات دلالة إحصائية في إجمالي الزيادة في الوزن، حيث كانت المتوسطات ٣٦٦، ٣٩٨، و٣٤١، والاستهلاك اليومي للعلف بمتوسطات ٩٠.٠، ٩٣.٩، و٨٨.٤، ومعامل التحويل الغذائي ٥.٧٢، ٤.٢٦، و٥.٩١ لمجموعة المقارنة، والعلف الملون بالأحمر، والعلف الملون بالأخضر على التوالي. أظهرت الطيور التي تغذت على العلف الملون بالأحمر أفضل أداء إنتاجي، حيث كان لها وزن جسم أعلى عند ٤ أسابيع، ومعدل زيادة وزنية أكبر، وتحسن في معامل التحويل الغذائي مقارنة بمجموعتي المقارنة والعلف الملون بالأخضر. ولكن في هذه الدراسة لم يكن هناك فروق ذات دلالة إحصائية بين المجموعات التجريبية على وزن البيض ووزن الجسم عند الفقس ونسبة الخصوبة، ونسبة الفقس ودورة وضع البيض والفترة بين الفقس والوضع التالي. استنادًا إلى هذه النتائج، فإن اللون الأحمر هو الأكثر فاعلية في تحسين الأداء الإنتاجي مقارنة بالعلف الملون بالأخضر ومجموعة المقارنة، في حين أن ألوان العلف المستخدمة في هذه الدراسة لم تحسن الصفات التناسلية خلال مدة التجربة. يُوصى بإجراء المزيد من البحوث لاستكشاف تأثير ألوان أخرى في علف الحمام لتحديد تأثيرها على الأداء الإنتاجي والتناسلي للحمام.