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# Effect Of Dried Orange Peels As Feed Replacement And Stocking Density On Broiler Productive Performance

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**Abstract**

This study was conducted at the poultry farm of Faculty of Agricultural Sciences, University of Sulaimani, in Bakrajo from 8/8/2014 to 1/1/2015. The experiment included managing and treating the birds at the farm to obtain the effect of Dried Orange Peels (DOP) levels on production performance of Ross-308 broilers at the **15-42 days** of age. The experiment was divided into five periods; each period lasted 7 days except fifth period lasted 15- 42 days. The birds were treated with different levels of DOP and different stocking density. The experimental treatments included eight treatments as following: **T1:** Control Diet + 0% dried orange peel+ normal stocking density (8 birds/$m^2$). **T2:** CD + 0% dried orange peel+ high stocking density (12 birds/$m^2$). **T3:** CD + 3% dried orange peel+ normal stocking density. **T4:** CD + 3% dried orange peel+ high stocking density**. T5:** CD + 6% dried orange peel+ normal stocking density. **T6:** CD + 6% dried orange peel+ high stocking density**. T7:** CD+ 9% dried orange peel+ normal stocking density. **T8:** CD + 9% dried orange peel+ high stocking density**.** The results obtained from this study showed that the effect of Dried Orange Peels (DOP) levels and stocking density significantly ($P \leq 0.05$) affected feed intake, body weight, body weight gain and feed conversion ratio.

## Introduction

The success of poultry production is based on feeding, breeding, marketing, good management and health status. Nutrition plays an important role in intensive chicken production [1].

Cereal grains especially maize which forms the bulk of energy in poultry feeds are in short supply as a result of industrial and human needs. This has resulted in competition between human and animal for available feed resources, and hence high cost of animal production [2]. Therefore, current research efforts are targeted towards the use of cheaper and readily available feed sources which are mostly agro-industrial by-products such as sweet orange (*Citrus sinensis*) fruit peels that can possibly replace or substitute conventional feed resources such as maize [3]. It is comparable in energy and protein to maize and not prone to pest attack like maize when dry [4].

Benefit effect is reducing the cost of feeds and thus makes poultry production profitable. Therefore, there is necessity to search for cheaper, non-competitive and readily available feed ingredients to replace the costly ones [4]. Peels represent between 50 to 65% of total weight of the fruits and remain as the primary byproduct, if not processed further, it becomes wet, produce odor, soil pollution and harborage for insects and can give rise to serious environmental pollution [5,6,7,8].

Stocking density has been a subject of serious concern in the feed and poultry industry [9] . One of the major welfare concerns in broiler production is detrimental effects of high stocking density, especially in the final weeks of growing period [10,11]. [12] showed that a stocking density in large flocks exceeding 16 birds /$m^2$ leads to compression of birds. There were studies on stocking density impact on unfavorable changes in health of broiler chickens, their production results, feed and water consumption, and carcass quality [13], even the researchers still look for answers regarding best housing system for rearing of slaughter and laying poultry [14,15]. Good production practice is the essential component of best available technique in intensive poultry production [16]. The main objectives of present study were to study the role of dried orange peel with stocking density on broiler performance traits.

## Materials and Methods

The present study was conducted at the poultry farm of Faculty of Agricultural Sciences, University of Sulaimani in Bakrajo from 8/8/2014 to 1/1/2015. The experiment included management and treating birds in the farm after examining different levels of dried peel of orange at different densities spaces and its effect on broiler performance.

## Experimental layout

The experiment was organized on broiler day old chicks belonging to the Ross-308, which were sacrificed at 42 days old with a density of normal (8 chicks/$m^2$) and high (12 chicks/$m^2$). The total birds of the experiment population were 448 broilers of hatched chicks (8 treatment's × 4 replications × 12 or 16 broilers). Broilers were randomly assigned into eight equal treatments (a control treatment and seven experimental treatments) which were reared in the same environmental conditions, two different densities (normal 12 birds/pen and high density 16 birds/pen) and four different composition diets (Control, %3, %6, %9 dried orange peels).

Table (1). The experimental treatments:

| *Density* | *T1 Control 0% Orange peel* | *T2 3% Orange peel* | *T3 6% Orange peel* | *T4 9% Orange peel,* |
|---|---|---|---|---|
| *Normal Density, D1* | *4 Replicates (Each with 12 birds/pen) ** | *4 Replicates (Each with 12 birds/pen) ** | *4 Replicates (Each with 12 birds/pen) ** | *4 Replicates (Each with 12 birds/pen) ** |
| *High Density, D2* | *4 Replicates (Each with 16 birds/pen) *** | *4 Replicates (Each with 16 birds/pen) *** | *4 Replicates (Each with 16 birds/pen) *** | *4 Replicates (Each with 16 birds/pen) *** |

*Each group combination replicated 4 times with 8 birds/$m^2$ and total of 48 birds.
** Each group combination replicated 4 times with 12 birds/ $m^2$ and total of 64 birds.

## Feeding

Chickens were fed with two recipes of compound mixtures, as follows: the starter up to 21 d and the finisher from 22 d to 42 d of age. The recipes of compound feed used had different levels of nutrition substances as following ratio and its chemical calculated component is shown in tables (2) and (3). Fresh orange (*Citrus sinensis*) fruit peel were collected daily from orange retail sellers in Sulaimani market, to prevent fermentation and other forms of deterioration, the peels were immediately sun-dried on concrete platforms, until crisp in January 2014. It was then milled to obtain the orange peel meal by (Hammer Milling) machine having a screening sieve of 1mm pores to obtain the citrus fruit peel meal, which was mixed with other feed ingredients to produce the experimental diets. Four experimental diets, designated as Control 0%, 3%, 6%, and 9% were compounded containing similar crude protein, energy and other nutrients, 0, 3, 6 and % 9 sweet orange peels (SOP) respectively. The nutritional requirement determined according to [17].

Table (2). Ingredient composition of the starter diet provided to the broiler from 15 d to 21 d of age

| Ingredient, % as feed-basis | Starter diet (1-21 days) | | | |
|---|---|---|---|---|
| | Control | Dried orange peel | | |
| | | %3 | %6 | %9 |
| Protein concentrate* | 8 | 8.5 | 8.5 | 8.5 |
| Dried Orange Peel | 0 | 3 | 6 | 9 |
| Soybean meal (%44) | 30.5 | 29.5 | 30 | 30.5 |
| Wheat | 10 | 18 | 14 | 8 |
| Wheat bran | 2 | 2 | 1 | 2 |
| Yellow Corn | 45.4 | 35.1 | 36.4 | 37.6 |
| Sunflower seed Oil** | 3.2 | 3 | 3.2 | 3.5 |
| Limestone | 0.5 | 0.5 | 0.5 | 0.5 |
| Salt (NaCl) | 0.3 | 0.3 | 0.3 | 0.3 |
| Mixture of Vitamin and minerals*** | 0.1 | 0.1 | 0.1 | 0.1 |
| Total | 100 | 100 | 100 | 100 |
| Calculated chemical analysis of the starter diet | | | | |
| Crude Protein% | 22.4 | 22.4 | 22.4 | 22.4 |
| ME (kcal/kg) | 3030 | 3043 | 3043 | 3043 |
| Calcium% | 0.8 | 0.8 | 0.8 | 0.8 |
| Phosphor% | 0.4 | 0.4 | 0.4 | 0.4 |
| Methionine% | 0.7 | 0.7 | 0.7 | 0.7 |
| Lysine% | 1.3 | 1.3 | 1.3 | 1.3 |

Table (3). Ingredient composition of the finisher diet provided to the broiler from 22 - 42 d of age

| Ingredient, % as feed-basis | Finisher diet (22-42 days) | | | |
|---|---|---|---|---|
| | Control | Dried orange peel | | |
| | | %3 | %6 | %9 |
| Protein concentrate* | 5 | 5.5 | 5.5 | 6 |
| Dried Orange Peel | 0 | 3 | 6 | 9 |
| Soybean meal (%44) | 27.5 | 30.2 | 30.2 | 30.2 |
| Wheat | 10 | 6 | 6 | 6 |
| Wheat bran | 0 | 2 | 2 | 2 |
| Yellow Corn | 53.5 | 47.3 | 44.3 | 40.8 |
| Sunflower seed Oil** | 3 | 5 | 5 | 5 |
| Limestone | 0.5 | 0.5 | 0.5 | 0.5 |
| Salt (NaCl) | 0.3 | 0.3 | 0.3 | 0.3 |
| Mixture of Vitamin and minerals*** | 0.2 | 0.2 | 0.2 | 0.2 |
| Total | 100 | 100 | 100 | 100 |
| Calculated chemical analysis of the finisher diet | | | | |
| Crude Protein% | 20.5 | 20.5 | 20.5 | 20.5 |
| ME (kcal/kg) | 3160 | 3100 | 3100 | 3100 |
| Calcium% | 0.8 | 0.8 | 0.8 | 0.8 |
| Phosphor% | 0.4 | 0.4 | 0.4 | 0.4 |
| Methionine% | 0.7 | 0.7 | 0.7 | 0.7 |
| Lysine% | 1.15 | 1.15 | 1.15 | 1.15 |

## Chemical composition of dried orange peel

A sample of the peels was analyzed for its proximate constituents (Table 4) using standard method recommended by [18].

Table (4). Proximate chemical composition of dried orange peel (DOP)

| Item of dried orange peel | Chemical composition (Percent) |
|---|---|
| Moisture | 14% |
| Crude protein | 6.5% |

| | |
|---|---|
| *Total carbohydrates* | *74%* |
| *Ether extract* | *2.1%* |
| *Ash* | *3.4%* |

## Studied traits:

### *Body weight*

Birds were weighed as replicates every week in each experimental unit throughout the experimental period by using (Rowenta) balance with the accuracy of (Max. 5kg, Min. 1g). Body weight gains were calculated as the difference between the initial and final BW of the week. During rearing period, BW was recorded at day 15, 22, 29, 36, 42 of broilers age

The gain of BW was calculated by the following formula:-

Body weight gain = weight at the end of the period - Weight at the beginning of the period

### *Feed intake*

Feed intake in each replicate was recorded and measured at the end of each week by subtracting non-eaten feed from total amount of feed supplied and daily feed intake was found by dividing weekly feed intake on 7 days.

### *Feed conversion ratio*

Feed conversion ratio is the amount of feed intake estimated to unit weight for each weight gain estimated in the same unit and.

## Statistical analysis

General Linear Model (GLM) within the statistical program XLSTAT (2004, version-7.5) was used to analyze the two factors namely the treatment and density affecting productive traits within the factorial Complete Randomized Design (CRD) (diets and density). Least significant difference test (L.S.D.) **was** used to determine the significance difference among the treatments means [19]. Level of significance used in all results was (0.05).

## Results and Discussion

### *Effects of dried orange peel and stocking density on body weight:*

Table (5) showed that there were significant differences (P≤0.05) between levels of DOP and densities during periods. P1, the highest mean was 0% of DOP/12 birds (822.750g), the lowest mean was 9% of DOP/12 birds (687.250g). For P2 the best mean was 0% of DOP/12 birds (1396.00g) differed from others except 0% of DOP/16 birds, whereas the lowest mean was 9% of DOP/16 birds (1161.250g). For P3 the best mean also was 0% of DOP/12 birds (2200.00g) differed from others except 0% of DOP/16 birds, whereas the lowest mean was 9% OF DOP/12 birds (1760.250g). For P4 the best mean was 0% OF DOP/12 birds (2912.750g), whereas the lowest mean was 9% of DOP/12 birds (2302.750g). Reducing the feed intake of birds of these diets may likely affect body weight which also rendered the chicks to obtain adequate nutrients needed from feed consumed to make their growth rate comparable with the control [20].

Table (5). Mean ± SEM of body weight (g) for different treatment combinations during the experiment.

| *Interaction* | | *Periods (days)* | | | | |
|---|---|---|---|---|---|---|
| *Dried orange peel's levels* | *Stocking density's levels* | *Initial weight (P0)* | *15 - 21 (P1)* | *22 - 28 (P2)* | *29 - 35 (P3)* | *36 - 42 (P4)* |
| *0%* | *12 birds* | *425.50±3.40* | *822.75±19.85* | *1396.00±21.90* | *2200.00±46.56* | *2912.75±61.94* |
| | *16 birds* | *396.75±6.08* | *797.25±20.45* | *1304.75±1.92* | *2 176.50±41.45* | *2771.75±90.90* |
| *3%* | *12 birds* | *384.50±16.11* | *733.75±12.65* | *1235.75±23.70* | *1966.50±48.43* | *2748.75±153.63* |
| | *16 birds* | *403.25±14.34* | *757.25±3.90* | *1236.00±29.94* | *2046.00±49.95* | *2596.75±43.18* |
| *6%* | *12 birds* | *378.75±7.59* | *717.25±24.57* | *1182.00±24.46* | *1953.75±99.44* | *2511.75±43.18* |
| | *16 birds* | *378.75±8017* | *719.25±19.76* | *1184.25±28.33* | *1883.25±48.41* | *2452.75±69.10* |
| *9%* | *12 birds* | *375.50±10.14* | *687.25±33.57* | *1164.75±70.43* | *1760.25±123.4* | *2302.75±168.91* |
| | *16 birds* | *405.25±16.77* | *718.25±15.39* | *1161.25±32.65* | *1884.75±53.84* | *2434.75±81.50* |
| *L.S.D.* | | *32.98* | *59.701* | *108.847* | *213.790* | *290.764* |

### *Effects of dried orange peel and stocking density on body weight gain:*

There were significant (P≤0.05) differences in body weights gain in P1 (Table 6). The highest body weight gain mean was 0% of DOP/16 birds (400.500g) and the lowest mean was in 9% of DOP/12 birds (311.750g). For P2 body weights gain means were significantly (P≤0.05) different. The highest mean was in 0% of DOP/12 birds (573.250g) and the lowest mean was in 9% of DOP/16 birds (443.00g). BWG means were significantly (P≤0.05) different in P3, higher mean 0% of DOP/16 birds (871.750g) did not differ from other except for 6% of DOP/16 birds, 9% of DOP/12 birds and 9% of DOP/16 birds (595.500g), which was the lowest mean. In P4 there were significant differences (P≤0.05) between body weights gain means, the highest mean was 3% for DOP/12 birds (782.250g) while, the lowest mean was 9% for DOP/16 birds (542.500g). In overall body weights gain means**,** there were significant (P≤0.05) differences, the best mean was 0% of DOP/12 birds (2487.250g) and the lowest mean was 9% for DOP/12 birds (1927.250g). The differences in body weight gain in interaction between stoking density with DOP were limited to a certain extent appeared to be caused by different levels of orange peel more than by differences in stocking densities.

Table (6). Mean ± SEM of body weight gain (g) for different treatment combination during the experiment.

| *Interaction* | | *Periods (week)* | | | | |
|---|---|---|---|---|---|---|
| *Dried orange peel's levels* | *Stocking density's levels* | *15 - 21 (P1)* | *22 - 28 (P2)* | *29 - 35 (P3)* | *36 - 42 (P4)* | *15 - 42 (P5) overall* |
| *0%* | *12 birds* | *397.25±19* | *573.25±32* | *804.00±27* | *712.75±2 4* | *2487.25 ±60* |
| | *16 birds* | *400.50±14* | *507.50±40* | *871.75 ±37.14* | *595.2 5±73* | *2375.00 ±85* |
| *3%* | *12 birds* | *349.25±12* | *502.00±14* | *730.75 ±25.74* | *782.2 5±114* | *2364.25 ±143* |
| | *16 birds* | *354.00±15* | *478.75±32* | *810.00 ±27* | *550.75± 69* | *2193.50 ±41* |
| *6%* | *12 birds* | *338.50±20* | *464.75±18* | *771.75 ±78* | *558.00± 70* | *2133.0 ±37* |
| | *16 birds* | *340.50±18* | *465.00±29* | *699.00 ±57* | *569.50± 62* | *2074.0 ±62* |
| *9%* | *12 birds* | *311.75±24* | *477.50±42* | *595.50 ±58.93* | *550.0 ±86* | *1927.25 ±159* |
| | *16 birds* | *313.0±21* | *443.0±36* | *723.50 ±62* | *542.5 ±45* | *2029.50 ±78* |
| *L.S.D.* | | | *0.23* | | *54.35* | *93.91* |

It seems that the depressed feed consumption in the orange peel based diets impaired the growth rate of the birds during starter period thereby making the control group to record a faster growth rate. This might had resulted from the inability of the experimental chicks to obtain adequate nutrients needed from the feed consu med to make their growth rate at least comparable with the control [21].

### *Effects of dried orange peel and stocking density on Feed intake:*

There were significant (P≤0.05) differences in different DOP levels on FI in all periods P1, P2, P3, P4 and overall shown in table (7). The highest mean was (507.378g) at 0% of DOP/12 birds for FI in P1 and the lowest mean was (357.917g) at 9% of DOP/12 birds. In P2 the highest mean was (831.273g) at 0% of DOP/12 birds and the lowest mean was at 9% of DOP/16 birds (637.359g), In P3 the highest mean was (1155.396g) at 0% of DOP/12 birds and the lowest mean was at 9% of DOP/16 birds (869.609g).

In P4 the highest mean was (1123.146g) at 0% of DOP/12 birds and the lowest mean was (820.906g) at 9% of DOP/16 birds. In overall period the highest mean was (3617.190g) at 0% of DOP/12 birds and the lowest mean was (2724.984g) at 9% of DOP/16 birds. From the results in all periods it can be noticed that differences in FI mostly from DOP level and less or non from SD. Combination of the two effects may produce this difference. Other factors that may contribute to reduced performance included poor air quality due to inadequate air exchange, increased ammonia, and reduced access to feed and water [22]. FI trends agreed with the fact that high SD decreased FI [23,24]. Poor palatability, aroma and other intrinsic anti-nutritional factors were identified as factors that affect intake of feeds containing unconventional grain

legume seed meals [25]. The presence of saponin and tannins in SOPM may confer bitter taste on the SOPM based diets, thereby reducing the FI of birds on these diets [26].

Table (7). Mean ± SEM of feed intake g/bird/week for different treatment combinations during the experiment.

| *Interaction* | | *Periods (week)* | | | | |
|---|---|---|---|---|---|---|
| *Dried orange peel's levels* | *Stocking density's levels* | *15 - 21 (P1)* | *22 - 28 (P2)* | *29 - 35 (P3)* | *36 - 42 (P4)* | *15 - 42 (P5) overall* |
| *0%* | *12 birds* | *507.37±7.42* | *831.27±20.87* | *1155.39±28.46* | *1123.14±18.36* | *3617.19±35.18* |
| | *16 birds* | *492.58±10.08* | *765.82±10.38* | *1042.07±14.74* | *952.20±16.16* | *3252.69±21.30* |
| *3%* | *12 birds* | *360.98±19.37* | *642.14±21.19* | *1011.71±44.81* | *879.47±44.97* | *2894.32±60.67* |
| | *16 birds* | *414.99±25.94* | *680.28±15.16* | *849.18±27.75* | *886.40±26.13* | *2830.86±65.27* |
| *6%* | *12 birds* | *375.83±12.44* | *706.16±29.74* | *974.12±45.94* | *983.22±36.53* | *3039.35±99.67* |
| | *16 birds* | *407.34±27.10* | *721.26±22.95* | *978.90 ±8.73* | *952.73±11.23* | *3060.25±68.17* |
| *9%* | *12 birds* | *357.91±11.12* | *674.35±24.25* | *936.91±55.28* | *896.06±19.09* | *2865.25±101.74* |
| | *16 birds* | *397.10±12.34* | *637.35±34.51* | *869.60±13.95* | *820.90±25.70* | *2724.98±48.86* |
| *L.S.D.* | | *50.247* | *68.567* | *99.229* | *78.523* | *198.39* |

### *Effects of dried orange peel and stocking density on Feed conversion ratio:*

Table (8) revealed the effect of interaction between DOP and SD on FCR during periods of age, the better FCR mean was in P1 3% of DOP/12 birds (1.04) and 6% of DOP/12 birds (1.11). In P4 was poorest FCR mean among all periods. In P1 9% of DOP/16 birds (1.29) was lower FCR mean, and the better mean was 3% of DOP/12 birds (1.04) which did not differ from others. P2 had no significant difference between means. The lower mean was 3% of DOP/16 birds (1.05) and the highest mean was 9% of DOP/12 birds (1.59) in P3 which was significantly ($p \leq 0.05$) different. P4 3% of DOP/12 birds (1.18) was better mean and 6% of DOP/12 birds (1.84) was lower mean. In overall 9% of DOP/12 birds (1.51) was the lower mean and 3% of DOP/12 birds (1.23) was the better mean.

Table (8). Mean ± SEM of Feed conversion ratio g feed/g weight for different treatment combinations during the experiment.

| *Interaction* | | *Periods (days)* | | | | |
|---|---|---|---|---|---|---|
| *Dried orange peel's levels* | *Stocking density's levels* | *15 - 21 (P1)* | *22 - 28 (P2)* | *29 - 35 (P3)* | *36 - 42 (P4)* | *15 - 42 (P5) overall* |
| *0%* | *12 birds* | *1.28 ±0.06* | *1.46 ±0.07* | *1.44 ±0.06* | *1.57 ± 0.03* | *1.45 ±0.03* |
| | *16 birds* | *1.23 ±0.03* | *1.54 ±0.13* | *1.20 ±0.06* | *1.67 ± 0.19* | *1.37 ±0.05* |
| *3%* | *12 birds* | *1.04 ±0.12* | *1.28 ±0.05* | *1.38 ±0.05* | *1.18 ± 0.13* | *1.23 ±0.05* |
| | *16 birds* | *1.18 ±0.09* | *1.43 ±0.07* | *1.05 ±0.05* | *1.70 ± 0.25* | *1.29 ±0.03* |
| *6%* | *12 birds* | *1.11 ±0.01* | *1.52 ±0.03* | *1.31 ±0.17* | *1.84 ± 0.22* | *1.42 ±0.07* |
| | *16 birds* | *1.21 ±0.09* | *1.56 ±0.07* | *1.42 ±0.11* | *1.75 ± 0.24* | *1.47 ±0.04* |
| *9%* | *12 birds* | *1.16 ±0.06* | *1.44 ±0.11* | *1.59 ±0.09* | *1.79 ± 0.30* | *1.51 ±0.10* |
| | *16 birds* | *1.29 ±0.11* | *1.47 ±0.16* | *1.22 ±0.09* | *1.52 ± 0.15* | *1.34 ±0.02* |
| *L.S.D.* | | *0.239* | *ns* | *0.280* | *0.605* | *0.172* |

The DOP in diets improved the feed conversion or the efficiency of feed utilization of broilers [27], the high contents of amino acids in the juice wastes mixtures (which also exist in DOP) such as tryptophan, lysine and threonine.

## Conclusion

Stocking density did not affect productive performance traits. Feed conversion ratio was not affected by dried orange peel and stocking density. Dried orange peel and stocking density were safe on chicken health and life because there were only 3 mortalities in whole periods which was not significantly different.

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