Effect of Supplementing Beetroot (Beta Vulgaris Rubra) Powder and Its Aqueous Extract on Productive Performance of Growing Geese

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Abstract

The present study aimed to investigate the influence of supplementing beetroot (Beta vulgaris rubra) powder and its aqueous extract on the productive performance of growing geese. A total of 180 one-day-old goslings chicks of Chinese white geese were randomly distributed among five treatment groups containing three replicates of 12 birds each. Five experimental diets were formulated as follows: Control diet without supplementation (T1). In the second and third treatments, the beetroot extract was supplemented at 15, and 30 (ml/l) in drinking water; 15, and 30 (g/kg) beetroot powder (T4, T5) in basal diet respectively. Results indicated significant (p≤0.05) improvement in average body weight and weight gain from the 2nd to 12th week and total weight gain in treatment T2 and T4, which achieved the highest values compared to the control. As for feed intake, the T3 in the 6th week, T1 in the 8th week, and T2 in the 10th week were consumed a greater amount of feed compared to the other treatments, while no significant differences appeared in the 2, 4, and 12 weeks of age and in the cumulative period. No significant differences in the feed conversion ratio at age 2, 10, and 12 weeks, while the T5 in the 4th week, T2 in the 6th week, and the T4 in the 8th week, and the cumulative period showed the better feed conversion ratio compared to the other treatments. In conclusion, the supplementation of beetroot extract at 15, 30 (ml/l) or beetroot powder at 15, 30 (g/kg) improved the productive performance of growing geese.

Keywords: Beta vulgaris rubra, Powder, Water extract, Productive traits, Geese.

1. Introduction

Besides nutrition, specialized organizations tended to focus on functional foods, which have an important role in public health. Beetroot is one of these foods, which previous studies indicate about its use as a natural medicine in the Roman era [1]. Beetroot is grown in all countries of the world for intake as well as for use as a food coloring, which is known as E162 [2]. Several bioactive compounds were beetroot have it, gave health for humans, especially for disorders characterized by chronic inflammation. This makes the main motive for the interest in beetroot as a result of its discovery as a nitrate diet source, which has important implications for heart and vascular health [3]. Studies have found results that eating provides beneficial physiological effects that lead to resistance to many diseases, such as: High blood pressure, arteriosclerosis and diabetes [4]. High blood pressure is specific to treatments and there are many studies that show beetroot, which is taken to significantly reduce systolic and diastolic blood pressure [5]. The effect of beetroot on blood vessels is largely due to its high inorganic nitrate content, as it contains 250 mg / kg of fresh weight [6]. The beneficial effects of nitrate are attributed to its in vivo reduction to nitric oxide (NO), a multi-species molecule that has an impact on important vascular and metabolic functions [7].

Nitrates are not the only beneficial compound in beetroot, which is rich in some phytochemicals (including ascorbic acid, carotenoids, phenolic acids and flavonoids), it also contains a group of highly biologically active pigments known as betalains, which were classified as either betacyanin pigments with a violet-red color, or yellow-orange betaxanthin pigments [1]. Betalains are considered antioxidant and anti-inflammatory as well as their role in clinical diseases, characterized by oxidative stress and chronic inflammation such as liver disease [8], arthritis [9], as well as cancer [10]. The addition of dried beetroot powder at a ratio of 1 and 2% in laying hens’ diets improved the average egg weight, but did not affect the color and viscosity of the yolk [11]. The use of freeze-dried carrot and beetroot powder at a percentage of 0.8% in laying hens’ diets increased the concentration of retinol (retinol) as well as the color of the yolk compared to the control diets [12]. The use of beetroot juice at a level of 10, 20 and 30 ml per liter of drinking water for a period of 8 weeks of age of broilers improved the productive characteristics as well as the characteristics of the carcass, especially the level of 30 ml per liter of drinking water [13].
This study aims to show the effect of added beetroot (*Beta vulgaris rubra*) powder and water extract to the diet and drinking water on some productive traits of geese.

### 2. Materials and Methods

#### 2.1 Experiment field

The field experiment was conducted in the Poultry Field, Department of Animal Production, College of Agriculture, University of Basrah, to determine the effect of supplemented beetroot (*Beta vulgaris rubua*) powder and its aqueous extract to diet and drinking water on productive performance of goose. A total of 180 one-day-old goslings chicks of Chinese white geese were randomly distributed among five treatment groups containing three replicates of 12 birds each. A total of 180 chicks of Chinese white geese were used, one day old, randomly distributed to five treatments, 36 chicks for each treatment and three replicates for each treatment (12 chicks for each replicate). The experimental treatments were as follows:

The experimental treatments consisted of a control diet without supplementation (T1). In the second and third treatments, the beetroot extract was supplemented at 15, and 30 (ml/l) in drinking water; 15, and 30 (g/kg) beetroot powder (T4, T5) in basal diet respectively, the control groups without any drinking water supplement.

All goose were kept under uniform management conditions throughout the experiment period. Gosling were fed approximately 20% crude protein; 2903 (kcal/kg) metabolizable energy until seven weeks of age, after which they received commercial diet 16.53% crude protein; 3031 kcal/kg metabolizable energy (Table 1). Water and feed were ad libitum till the end of the experiment. The experimental diets were formulated to meet the nutritional requirements of growing geese proposed by the NRC [14]. The chemical composition of beetroot powder was analyzed according to the methods in AOAC [15] (Table 2). Beetroot powder has been added to the basal diet, as well as the aqueous extract was supplemented to the drinking water throughout the trial period.

**Table 1.** Ingredients and nutrient composition of goose starter and grower diets.

| Ingredients (%) | Starter diet 1-7 weeks | Grower diet 8-12 weeks |
|-----------------|-------------------------|------------------------|
| Maize           | 48.00                   | 52.00                  |
| Wheat           | 20.00                   | 18.00                  |
| Soybean meal (44% CP) | 25.00          | 12.00                  |
| plant oil       | 0.00                    | 1.50                   |
| Beans           | 0.00                    | 9.00                   |
| 1 protein concentrates (40%) | 5.00           | 5.00                   |
| Limestone       | 1.00                    | 1.00                   |
| Di-calcium phosphate | 0.50               | 1.00                   |
| Premix          | 0.25                    | 0.25                   |
| Salt            | 0.25                    | 0.25                   |
| Total           | 100                     | 100                    |

1 `Calculated analysis (%)

| Metabolizable energy (Kcal/Kg) | 2903 | 3031 |
| Crude protein                 | 20.00 | 16.53 |
| Crude fat                     | 2.57  | 2.72  |
| Crude fiber                   | 3.38  | 3.19  |
| Calcium                       | 0.78  | 0.98  |
| Phosphorus available          | 0.35  | 0.43  |
| Lysine                        | 1.06  | 0.85  |
| Methionine + Cysteine         | 0.70  | 0.69  |

1 `protein concentrate Provides per kg of diet: Crude protein 40%, 2017 kcal/kg M.E, 5% fat, 2.20% crude fiber, 7.10% moisture, 28.30% ash, 4.20% calcium, 2.65% total phosphorus, 3.85% lysine, 3.70% methionine, 4.12% methionine+cysteine, 0.42% tryptophan, 1.70% threonine, 2.50% sodium, 4.20% chloride, 200 mg/kg copper, 1.600 mg/kg manganese, 2.000 mg/kg zinc, 2.000 mg/kg iron, 20.00 mg/kg iodine, 5.00 mg/kg selenium. 2 `Calculated according to NRC [14].

2.2 Analysis of Variance

The data were analyzed using the statistical package program (SPSS) and the results were considered statistically significant at the level of (P<0.05).
2.2 Preparation of aqueous extract of beetroot

Beetroot samples were brought from the local market, washed, dried and ground, 20 g of powder was taken and placed in 250 ml distilled water for the purpose of preparing the aqueous extract, placed in a vibrator for one hour, the extract was filtered by filter paper (Whatman No 1) and the filtrate was concentrated by a water bath at 50 °C until full drying [17].

Productive traits: Body weight, weight gain, feed intake, and feed conversion ratio were measured every two weeks. A C.R.D was used, significant differences between means were tested using the revised L.S.D test. The statistical program SPSS [18] was used to analyze the data.

3. Results and discussions

3.1 Body weight

Table (3) shows the effect of adding beetroot on the body weight mean of Chinese geese, no significant differences between all treatments at the beginning of the experiment, at the second and fourth week, a significant increase (P≤0.05) was noted for the T2 treatment compared to the control treatment, in the sixth week Eighth and tenth, there was a significant increase (P≤0.05) in treatment T2 compared to treatment T3, which was significantly superior compared to treatment T5 significantly superior compared to the control treatment. At the end of the experiment (12 weeks old) treatment T2 and T4 were significantly superior to treatment T3 and T5 compared to treatment T3 and T5 at the expense of the control. And the final average body weight was 2620.23, 3094.63, 2890.76, 3066.56 and 2800.00 g for all experiment treatments, respectively.

Table 3. Effect of supplementation of beetroot powder and its aqueous extract on body weight (g) of geese.

| Treatment | Age (week) |
|-----------|------------|
|           | Start 2 | 4 | 6 | 8 | 10 | 12 |
| T1        | 78.78   | 287.50b | 518.23c | 904.80d | 1344.00d | 2013.46d | 2620.23c |
| T2        | 80.37   | 333.04a | 593.73a | 1053.86a | 1606.30a | 2351.03a | 3094.63a |
| T3        | 78.79   | 304.51abc | 555.40bc | 995.50b | 1479.53c | 2197.96c | 2890.76b |
| T4        | 81.31   | 320.10ab | 576.46ab | 1023.56ab | 1541.80b | 2272.20 b | 3066.56a |
| T5        | 78.79   | 291.93bc | 542.10bc | 959.00c | 1446.71c | 2151.96c | 2800.00b |
| Sig.      | N.S     | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |

3.2 Weight gain

Table (4) show that the effect of added beetroot (Beta vulgaris rubua) powder and its aqueous extract to diet and drinking water on weight gain mean of geese, there was a significant increase (P≤0.05) in the weekly weight gain of the T2 treatment compared to the control and T5 treatments at the second week of the geese's age. At the fourth and tenth weeks, no significant differences were observed between all treatments. At the sixth and eighth weeks, the weekly weight gain increased significantly (P≤0.05) in the T2 treatment compared to the control treatment. At the last week of the experiment (12 weeks old), there was a significant increase (P≤0.05) in the T4 treatment compared to the control and T5 treatments, when studying the total weight gain, a significant increase (P≤0.05) was observed in treatments T2 and T4 compared to treatments T3 and T5, which showed a significant superiority compared to the control treatment. The total weight gain was 2541.44, 3014.26, 2811.97, 2985.25 and 2721.20 g for all treatments, respectively.
Table 4. Effect of supplementation of beetroot powder and its aqueous extract on weight gain (g) of geese.

| Treatment | Age (week) | 2     | 4     | 6     | 8     | 10    | 12    | Total   |
|-----------|------------|-------|-------|-------|-------|-------|-------|---------|
| T1        | 208.71b    | 230.73| 386.56b| 439.20b| 669.46| 606.76b| 2541.44c|
| T2        | 252.66a    | 260.69| 460.13a| 552.43a| 744.73| 743.60ab| 3014.26a|
| T3        | 225.72ab   | 250.88| 440.10ab| 484.03ab| 718.43| 692.80ab| 2811.97b|
| T4        | 238.79ab   | 256.36| 447.10ab| 518.23a| 730.40| 794.36a| 2985.25a|
| T5        | 213.14b    | 250.16| 416.90ab| 487.71ab| 705.25| 648.03b| 2721.20b|
| Sig.      | 0.05       | N.S.  | 0.05   | 0.05   | 0.05  | N.S.  | 0.05  |

3.3 Feed intake

Table (5) shows the effect of added beetroot (Beta vulgaris rubua) powder and its aqueous extract to diet and drinking water on feed intake (g) of geese. There were no significant differences between all treatments at the second, fourth, twelfth and the cumulative feed intake. At the sixth week, a significant increase (P<0.05) was observed for treatment T2 compared to all treatments. At the eighth week, a significant increase (P<0.05) was observed in the rate of feed intake in the control treatment compared to treatments T4 and T5. At the tenth week, a significant superiority of the T5 treatment was observed compared to the control and T4 treatment, and the total feed intake rate was 8252.11, 8795.78, 8748.83, 7880.98 and 7995.03 g for all treatments, respectively.

Table 5. Effect of added beetroot (Beta vulgaris rubua) powder and its aqueous extract to diet and drinking water on feed intake (g) of geese.

| Treatment | Age (week) | 2     | 4     | 6     | 8     | 10    | 12    | Total   |
|-----------|------------|-------|-------|-------|-------|-------|-------|---------|
| T1        | 225.01     | 793.00| 1657.96b| 1922.23a| 2256.66b| 1397.23| 8252.11|
| T2        | 265.89     | 780.99| 1506.03b| 1778.60ab| 2559.50ab| 1904.76| 8795.78|
| T3        | 257.06     | 703.90| 2195.20a| 1589.93abc| 2483.30ab| 1519.43| 8748.83|
| T4        | 258.53     | 785.06| 1651.26b| 1400.58bc| 2241.66b| 1543.86| 7880.98|
| T5        | 254.59     | 659.25| 1428.60b| 1329.79c| 2714.00a| 1608.80| 7995.03|
| Sig.      | N.S.       | N.S.  | 0.05   | 0.05   | 0.05  | N.S.  | N.S.  |

3.4 Feed conversion

Table (6) show the effect of supplementation of beetroot powder and its aqueous extract on feed conversion ratio (g/g) of geese. The results indicate that there are no significant differences between the treatments at 2, 10 and 12 weeks of age of the geese, at the fourth week of the bird’s age, a significant superiority (P<0.05) was obtained for the T5 treatment compared to the control treatment, at the sixth week of the birds’ age, a significant superiority was obtained for the T2 compared to the control. With the control and T3 treatment, at the eighth week, all beetroot treatments were significantly superior (P<0.05) compared to the control treatment, and at the cumulative food conversion ratio, the T4 treatment was superior compared to the control and T3 treatments. The feed conversion ratio was 3.24, 2.91, 3.11, 2.64 and 2.93 (g/g) for all treatments, respectively.

Table 6. Effect of added beetroot (Beta vulgaris rubua) powder and its aqueous extract to diet and drinking water on feed conversion (g diet/ g weight gain) of geese.

| Treatment | Age (week) | 2     | 4     | 6     | 8     | 10    | 12    | Total   |
|-----------|------------|-------|-------|-------|-------|-------|-------|---------|
| T1        | 1.08       | 3.34b | 4.28bc| 4.36b | 3.38  | 2.29  | 3.24b |
| T2        | 1.05       | 3.00ab| 3.30a | 3.22a | 3.44  | 2.58  | 2.91ab|
| T3        | 1.13       | 2.82ab| 4.98c | 3.31a | 3.47  | 2.27  | 3.11b |
| T4        | 1.08       | 3.06ab| 3.70ab| 2.70a | 3.07  | 1.94  | 2.64a |
| T5        | 1.19       | 2.63a | 3.42ab| 2.72a | 3.86  | 2.48  | 2.93ab|
| Sig.      | N.S.       | 0.05  | 0.05  | 0.05  | N.S.  | N.S.  | 0.05  |

Beetroot is rich in antioxidants. Several invitro studies have that betalain pigments a particular protect cellular components from oxidative damage [19], in the study by Kanner et al. [20]. Two betalain metabolites betanin and betanidin have been shown to reduce linoleate damage induced by cytochrome C oxidase and lipid membrane oxidation induced by H2O2-activated methemoglobin and free iron (AA-Fe). Beetalin is high in beetroot (300-600 mg/kg), and is more effective in inhibiting lipid peroxidation. The high antioxidant activity of betanin appears to stem from its exceptional electron-donati. Beetroot protects against oxidative damage to DNA, fats and proteins [21]. The main mechanism of beetroot juice as an
antioxidant is through the purification of free radicals [22]. Commercial beetroot juices inhibit the in vitro free radical formation of (DPPH) and (ABTS) by 100 and 92, respectively. Beetroot juices still retain 55% of their pre-digesting radical scavenging capacity, the antioxidant capacity of both drinks, according to the Ferric Antioxidant Potency (FRAP) measure, they were higher than those in other vegetable juice drinks. That the FRAP of beetroot juice rises after digestion, because of changing the composition of a number of compounds as antioxidants, the antioxidant capacity of beetroot juice in both (DPPH) and FRAP, they were much larger than those found in other vegetable juices, such as tomatoes and carrots, which has high antioxidant capacity in FRAP test [23 24, 25].

Conclusions

We conclude from our current study that the use of water extract of beetroot powder at a ratio of 15 and 30 ml / liter of drinking water, and beetroot powder to diet at a ratio of 15 and 30 g / kg of diet has significantly improved the productive performance of geese. We recommend conducting future studies for other levels of beetroot powder, whether in drinking water or Feed to show its effect on the productive performance of geese.

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