

## ARTICLE / INVESTIGACIÓN

## Effect of adding beetroot (*Beta vulgaris rubra*) powder and its aqueous extract to growing geese carcasses on carcass quality and measures

Saad K.J. Al-waeli<sup>1</sup>, Majid H.A. Alasadi<sup>2</sup> and Rabia J. Abbas<sup>2\*</sup>

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<sup>1</sup>Animal Production Department, College of Agriculture, Al-Muthanna University, Iraq.<sup>2</sup>Animal Production Department, College of Agriculture, University of Basrah, Iraq.

Corresponding author: saadkadhim1962@gmail.com

**Abstract:** The present study investigated the influence of supplementing beetroot (*Beta vulgaris rubra*) powder and its aqueous extract on growing goose's carcass quality and carcass measurements. One hundred eighty 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). T2 and T3, 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 indicate that the use of beetroot significantly improved all traits of the studied goose carcass compared to the control treatment, the addition of the aqueous extract at a concentration of 15 ml/ liter of drinking water and beetroot powder at a concentration of 15 g to the feed gave the best results and significantly compared to the rest of the treatments.

**Key words:** Beetroot (*Beta vulgaris rubra*), carcass quality, carcass measurements, growing goose.

### Introduction

Beetroot is a rich source of phytochemical compounds, including ascorbic acid, carotenoids, phenolic acids, and flavonoids, as well as containing a group of highly biologically active pigments known as Betacaine, which are classified as either betacyanin pigments with a red-violet color or Betaxanthin yellow-orange pigments<sup>1</sup>. Betalains are antioxidant and anti-inflammatory, in addition to their role in combating clinical diseases characterized by oxidative stress and chronic inflammation, such as liver disease<sup>2</sup>, arthritis<sup>3,4</sup>, and cancer<sup>5</sup>.

The plant extract of beetroot, ginger root and tomato at a concentration of 0.5 and 1.0%, it did not differ significantly in the dressing percentage, the relative weight of the liver (Liver), the gizzard, the heart (Heart) and abdominal fat, compared with the control treatment of broiler carcasses of Arbor Acres hybrid broilers<sup>6,7</sup>.

Moreover, (8) explains that drinking water is served with beetroot juice at levels of 10, 20 and 30 ml/liter of drinking water, it significantly improved the percentage of dressing with edible viscera of Marshal crossbred broiler carcasses, the level of 20 and 30 ml/liter of drinking water improved the relative weight of the heart compared to the control treatment, the level of 30 ml/liter of drinking water gave the best rates, significantly, compared to the level of 10 ml/liter of drinking water and the control treatment in the relative weight of the liver, no significant differences were observed among all treatments in the relative weight of gizzard, thigh and breast.

The current study aims to show the effect of supplementing beetroot (*Beta vulgaris rubra*) powder and its aqueous extract on carcass quality and carcass measurements of growing goose.

### Materials and methods

The study was conducted in the Poultry Field, Department of Animal Production, College of Agriculture, University of Basrah, to determine the effect of supplementing beetroot (*Beta vulgaris rubra*) powder and its aqueous extract on carcass quality and carcass measurements of growing goose.

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). T2 and T3, 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 geese 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 a commercial diet of 16.53% crude protein; 3031 kcal/kg) metabolizable energy as shown in 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<sup>9</sup>. The chemical composition of beetroot powder was analyzed according to the methods in AOAC<sup>10</sup>, as shown in Table 2. Beetroot powder was added to the basal diet, and the aqueous extract was supplemented with drinking water throughout the trial period.

Beetroot samples were brought from the local market, washed, dried, and ground, 20 g of powder was taken and

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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
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	100.00	100.00
<b>Calculated analysis</b>		
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

Protein concentrate Provides per kg of diet:: Crude protein 40%, 2017 kcal/kg ME, 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. 2Calculated according to NRC<sup>9</sup>.

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

placed in 250 ml distilled water to prepare the aqueous extract, placed in a vibrator for one hour, the extract was filtered by filter paper (Whatman No 1) and a water bath concentrated the filtrate at 50 °C until full drying<sup>12</sup>.

## Results

Table 3 shows the effect of beetroot (*Beta vulgaris rubra*) powder and its aqueous extract to the ration and drinking water on carcass weight and dressing ratio with or without giblet of goose carcasses (mean ± standard error), there was a significant effect of beetroot on carcass weight, as treatments T4 and T2 were significantly ( $P \leq 0.05$ ) outperformed compared to treatment T3, which was significantly ( $P \leq 0.05$ ) superior to treatment T5, which was significantly superior to the control treatment, the average carcass weight was 1690.41, 2103.41, 1933.43, 2079.53 and 1853.55 g for treatments T1, T2, T3, T4 and T5, respectively.

As for the dressing ratio with and without giblet, it was also noticed that T2 and T4 were significantly superior to the treatment of T5, in turn significantly superior at the expense of the control treatment. There are no significant differences between the treatments T2, T3 and T4 and the treat-

ments T3 and T4. The dressing percentage without giblet was 64.51, 67.97, 66.88, 67.81 and 66.20%, the dressing percentage with giblet was 69.48, 73.56, 72.13, 73.37 and 71.40% for treatments T1, T2, T3, T4 and T5, respectively.

Table 4 shows the effect of beetroot (*Beta vulgaris rubra*) powder and its aqueous extract to the ration and drinking water on the relative weight of giblet and belly fat of goose carcasses; there was no significant effect of all experimental treatments on the relative weight of the heart. The mean relative weight of the heart was 0.64, 0.68, 0.66, 0.67 and 0.65% for the T1, T2, T3, T4 and T5 treatments, respectively.

As for the relative weight of gizzard and liver (Table 4), there was a significant effect of beetroot treatments, the relative weight of gizzard and liver increased significantly ( $P \leq 0.05$ ) in treatments T2 and T4 compared to treatments T3 and T5, which showed a significant difference ( $P \leq 0.05$ ) compared to the control treatment, there were no significant differences between treatments T2 and T4 and treatments T3 and T5, the relative weight of the gizzard was 2.23, 2.68, 2.40, 2.66 and 2.37%, the relative weight of the liver was 2.09, 2.23, 2.18, 2.22 and 2.17% for the T1, T2, T3, T4 and T5 treatments, respectively.

As for relative weight of abdominal fat, a significant

Nutrients (%)	Beetroot powder
Dry matter	16.77
Crude protein	1.50
Ether Extract	0.13
Total ash	5.26
Crude fiber	6.20
Nitrogen free extract	0.17
Organic matter	0.39
Metabolized Energy (Kcal/kg)	428.15

**Table 2.** The beetroot powder's chemical composition (% on a dry weight basis).

The equation described<sup>11</sup> calculated metabolized energy.

Treatments	Carcass weight (gm)	dressing percentage without giblet	dressing percentage with giblet
T1	21.16±1690.41d	0.77±64.51c	0.74±69.48c
T2	0.65±2103.41a	0.05±67.97a	0.05±73.56a
T3	14.13±1933.43b	0.37±66.88ab	0.38±72.13ab
T4	3.56±2079.53a	0.14±67.81a	0.12±73.37a
T5	12.42±1853.55c	0.52±66.20b	0.52±71.40b
Sig.	0.05	0.05	0.05

**Table 3.** Effect of beetroot (*Beta vulgaris rubra*) powder and its aqueous extract to diet and drinking water on carcass weight, dressing percentage with and without giblet of goose carcasses (mean ± standard error).

Treatments	relative weight			
	heart	gizzard	liver	abdominal fat
T1	0.010±0.64	c0.050±2.23	c0.008±2.09	2.03 a±0.014
T2	0.005±0.68	a0.006±2.68	a0.012±2.23	1.68 c±0.010
T3	0.008±0.66	b0.012±2.40	b0.003±2.18	1.77 b±0.020
T4	0.012±0.67	a0.012±2.66	a0.008±2.22	1.71 c±0.015
T5	0.006±0.65	b0.020±2.37	b0.013±2.17	1.80 b±0.012
Sig.	NS	0.05	0.05	0.05

**Table 4.** Effect of beetroot (*Beta vulgaris rubra*) powder and its aqueous extract to diet and drinking water on the relative weight of giblet and belly fat of goose carcasses (mean ± standard error).

decrease ( $P \leq 0.05$ ) was observed in treatments T2 and T4 compared to treatments T3 and T5, which showed a significant decrease ( $P \leq 0.05$ ) compared to the control treatment, there were no significant differences between treatments T2 and T4 and treatments T3 and T5. The relative weight of abdominal fat was 2.03, 1.68, 1.77, 1.71 and 1.80% for the treatments T1, T2, T3, T4 and T5, respectively.

Table (5) shows the effect of beetroot powder (*Beta vulgaris rubra*) and its aqueous extract to diet and drinking water on the relative weight of the breast and thigh of goose carcasses, there was a significant effect ( $P \leq 0.05$ ) of bee-

root treatments on the relative weight of the breast and thigh, there was a significant increase ( $P \leq 0.05$ ) on the relative weight of the breast in treatments T2 and T4 compared to treatments T3 and T5, which showed a significant ( $P \leq 0.05$ ) superiority compared to the control treatment. There were no significant differences between treatments T2 and T4 and treatments T3 and T5. The mean RWR was 25.88, 27.47, 26.58, 27.24 and 26.40% for the T1, T2, T3, T4 and T5 treatments, respectively.

As for the relative weight of the thigh, there was a significant increase ( $P \leq 0.05$ ) in treatments T2 and T4 compared

to treatment T3, a significantly superior ( $P \leq 0.05$ ) compared to T5, which was significantly ( $P \leq 0.05$ ) superior to the control treatment, the mean relative weight of the thigh was 19.96, 20.85, 20.46, 20.76 and 20.28% for the T1, T2, T3, T4 and T5 treatments, respectively.

Table 6 indicates the effect of beetroot (*Beta vulgaris rubra*) powder and its aqueous extract to diet and drinking water on carcass length, keel bone length, thigh circumference and body fullness of goose carcasses (mean  $\pm$  standard error). It was noticed that there was a significant increase ( $P \leq 0.05$ ) in carcass length for treatment T2 compared to treatment T5 that was significantly superior ( $P \leq 0.05$ ) compare with control treatment. There were no significant differences between the treatments T2, T3 and T4 and the treatments T3, T4 and T5. Average carcass length was 28.67, 32.67, 31.00, 32.00 and 30.33 cm for T1, T2, T3, T4 and T5 treatments, respectively.

As for keel bone length, it was noted that there is a significant increase ( $P \leq 0.05$ ) for treatments T2 and T4 compared to treatments T3 and T5, which showed a significant increase ( $P \leq 0.05$ ) compared to the control treatment, there were no significant differences between treatments T2 and T4 and treatments T3 and T5. The mean keel bone length was 10.33, 11.96, 10.93, 11.80 and 10.83 cm for parameters T1, T2, T3, T4 and T5, respectively.

The results indicate a significant increase ( $P \leq 0.05$ ) in thigh circumference for treatments T2 and T4 compared to treatments T1, T3 and T5. There were no significant differences between treatments T2 and T4 and between treatments T1, T3 and T5. The mean thigh circumference was

18.67, 22.90, 20.33, 22.67 and 20.00 cm for T1, T2, T3, T4 and T5 parameters, respectively.

As for the degree of body fullness, a significant increase ( $P \leq 0.05$ ) was observed in the T4 treatment compared to the control treatment, there were no significant differences between T2, T3 and T4 and T2, T3 and T5 and T1, T3 and T5 treatments. Body fullness was 58.97, 64.40, 62.41, 65.02 and 61.14 cm for T1, T2, T3, T4 and T5 parameters, respectively.

Table 7 shows the effect of beetroot (*Beta vulgaris rubra*) powder and its aqueous extract on diet and drinking water on goose carcasses' length, circumference and breast fullness (mean  $\pm$  standard error). There was a significant ( $P \leq 0.05$ ) increase in breast length in treatments T2 and T4 compared to treatments T3 and T5, which showed a significant increase ( $P \leq 0.05$ ) compared to the control treatment. There were no significant differences between treatments T2 and T4 and treatments T3 and T5. Average breast length was 18.83, 22.50, 21.16, 22.33 and 20.33 cm for parameters T1, T2, T3, T4 and T5, respectively.

As for the breast circumference, it was noted that all beetroot treatments were significantly ( $P \leq 0.05$ ) superior to the control treatment. The mean breast circumference was 29.33, 32.67, 31.67, 32.33 and 31.33 cm for T1, T2, T3, T4 and T5 parameters, respectively.

There are no significant differences between all the treatments in the degree of breast fullness, the average was 1.021, 1.000, 1.022, 1.011 and 1.033 cm for coefficients T1, T2, T3, T4 and T5, respectively.

Treatments	relative weight	
	breast	thigh
T1	c0.06 $\pm$ 25.88	d0.07 $\pm$ 19.96
T2	a0.03 $\pm$ 27.47	a0.03 $\pm$ 20.85
T3	b0.02 $\pm$ 26.58	b0.02 $\pm$ 20.46
T4	a0.04 $\pm$ 27.24	a0.03 $\pm$ 20.76
T5	b0.27 $\pm$ 26.40	c0.02 $\pm$ 20.28
Sig.	0.05	0.05

**Table 5.** Effect of beetroot (*Beta vulgaris rubra*) powder and its aqueous extract to diet and drinking water on the relative weight of breast and thigh of goose carcasses (mean  $\pm$  standard error).

Treatments	Carcass length (cm)	keel bone length (cm)	thigh circumference (cm)	body fullness (cm)
T1	0.33 $\pm$ 28.67c	0.08 $\pm$ 10.33c	0.33 $\pm$ 18.67b	0.91 $\pm$ 58.97 c
T2	0.33 $\pm$ 32.67a	0.08 $\pm$ 11.96a	0.10 $\pm$ 22.90a	0.68 $\pm$ 64.40 ab
T3	0.57 $\pm$ 31.00ab	0.08 $\pm$ 10.93b	0.88 $\pm$ 20.33b	1.29 $\pm$ 62.41 abc
T4	0.57 $\pm$ 32.00ab	0.05 $\pm$ 11.80a	0.33 $\pm$ 22.67a	1.27 $\pm$ 65.02 a
T5	0.67 $\pm$ 30.33b	0.08 $\pm$ 10.83b	0.33 $\pm$ 20.00b	0.95 $\pm$ 61.14 bc
Sig.	0.05	0.05	0.05	0.05

**Table 6.** Effect of beetroot (*Beta vulgaris rubra*) powder and its aqueous extract to diet and drinking water on carcass length, keel bone length, thigh circumference and body fullness of goose carcasses (mean  $\pm$  standard error).

Treatments	Breast length (cm)	Breast circumference (cm)	Breast fullness (cm)
T1	0.17±18.83c	0.33±29.33b	0.023±1.021
T2	0.28±22.50a	0.33±32.67a	0.017±1.000
T3	0.44±21.16b	0.33±31.67a	0.010±1.022
T4	0.33±22.33a	0.33±32.33a	0.020±1.011
T5	0.33±20.33b	0.67±31.33a	0.0007±1.033
Sig.	0.05	0.05	NS

**Table 7.** Effect of beetroot (*Beta vulgaris rubra*) powder and its aqueous extract to diet and drinking water on carcass length, keel bone length, thigh circumference and body fullness of goose carcasses (mean ± standard error).

## Discussion

The use of beetroot, whether as an aqueous extract in drinking water or as a powder in fodder, significantly improved the characteristics of the studied carcass.

This improvement may be due to the improvement in the average weight of the carcass, which leads to an improvement in the characteristics of the carcass, or it may be because beetroot contains effective compounds, the most important of which is betalain, which has an important role as an antioxidant. Moreover, beetroot also improves the health of the digestive system, improves lipid metabolism, and has antioxidant and lipid peroxidation inhibitory effects<sup>14-16</sup>.

## Conclusions

Results indicate that the use of beetroot significantly improved all traits of the studied goose carcass compared to the control treatment, the addition of the aqueous extract at a concentration of 15 ml/ liter of drinking water and beetroot powder at a concentration of 15 g to the feed gave the best results and significantly compared to the rest of the treatments.

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