Impact of supplementation three types of vegetable in broiler diet on chicken meat: production properties

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Abstract

The aim of the study was to determine the effect of dietary additive consisting out of parsley, celery and cress on quantity and quality properties of meat from broiler chickens. At fourteen -day old, 100 broilers were divided equally on floor pens into 4groups. Treatments are dividing as C (control): without any additive to diet using stander diet, T1: using basal diet plus 10 gm parsley/kg of diet, T2: using basal diet plus 10 gm celery/kg of diet, and T3: using basal diet plus 10 gm cress/kg of diet. At the end of this experiment, broilers were (5/group) were slaughtered and the caresses were dissected, then the portions were weighted. Broilers had a significant effect ($P \leq 0.05$) on performance, with high percentages recorded across all groups fed with parsley, celery, and cress as feed additives, showing a notable improvement ($P \leq 0.05$). Using these plants in feed is economically beneficial, as they contribute to faster weight gain within a shorter breeding period and result in improved feed conversion ratio.

Keywords: *feed; broiler; meat; production properties*

Introduction

Poultry meat consumption in Europe grew by 2% per year from 2011 to 2021. The increasing rate consumption of 1.4% (was in 2022) was expected to continue for the next 8 years. There are several factors contributing to the increased demand for poultry meat including of short production cycles (35 to 42 days), affordability, good nutritional values and lack of religious constraints (European Commission 2021; Serra et al. 2024). Natural plant supplements are becoming increasingly popular in poultry diets, particularly for their positive impact on poultry health on side and on the quality, antioxidant properties and oxidative processes of meat on another side (Cristo et al. 2022). Feed additives can be used to improve animal performance and feed utilization qualifications (Gudev et al. 2008). By include more herbal plants in the diet, the pancreatic secretions such as digestive enzymes that aid in the digestion and absorption of additional amino acids from the digestive tract can increase (Lee et al. 2004; Mansoub 2011). The therapeutic plants, herbs, and extracts from them were used to make antiquated medications, which were consistently found to be safe. However, a lot of synthetic chemicals have a lot of negative consequences for humans, plants, and animals. The World Health Organization (WHO) advises switching back to nature by using therapeutic plants and herbs in place of chemicals in the pharma industry (Allam et al. 1999). Celery, parsley, and cress are rich in minerals including calcium, potassium, and iron as well as vitamins A, C, thiamin, riboflavin, and niacin (DerMarderosian and Beutler 2002) and their ascorbic acid content makes them ideal blood purifiers. It has several potential medical properties, such as being diuretic and relieving bloat in the abdomen. It also has improved blood components

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(Baytop 1984), is bactericidal or static (Wong and Kitts 2006), anticoagulant, antihyperlipidemic, antihepatotoxic (Oztürk et al. 1991), antioxidant (Nielsen et al. 1999), and stimulates or facilitates bowel evacuation (Kreydiyyeh et al. 2001).

Parsley has a high vitamin C content, four times that of a lemon, as well as high levels of flavones and the unique material apigenin, which works to reduce the division of cancer cells, aiding in the treatment of the disease and slowing its spread (Nielsen et al. 1999). These factors make parsley one of the antagonists to oxidize cells that protect them from cancer and develop the immune system. The leaves, roots, and seeds of garden cress are regarded as one of the widely used therapeutic herbs that are effective at promoting the healing of bone fractures in many different countries (Wadhwa et al. 2012). The aim of the current study was to ascertain the impact of adding celery, parsley, and cress to the diet on quantity properties of chicken meat.

Materials and Methods

This study was conducted at Shaqlawa Technical College / polytechnic University- Erbil. A total of 100 broiler of the Ross -308 line aged fourteen-day old were divided equally on floor pens into 4 groups (n=25 for each group) with five replicates (n=5 for each replicate). Basal diet of poultry was obtained from Erbil Feed Company for Feed Industry, located in Qush Tapa, Erbil, Iraq. The ratios of feed composition (basal diet) where according to our requirement from the feed company. The fresh vegetable (only leafs) feed additive including of parsley, celery and cress were obtained from retail marked of Shaglawa city. The feed treatments which are used for feeding the 4 groups of broiler were divided as follows:

C: using stander diet free as control
T1: using basal diet plus 10 gm Parsley (*Petroselinum crispum*) fresh /Kg of diet
T2: using basal diet plus 10 gm Celery (*Apium graveolens*) fresh /Kg of diet
T3: using basal diet plus 10gm Cress (*Lepidium sativum*) fresh /Kg of diet
The composition of feed including of basal diet and vegetable additives which are used as experiment treatments as shows in Table 1.

Table 1. Feed Composition of treatments.

Feed Ingredients	C	T2	T3	T4
Yellow corn%	47.2	46.7	46.7	46.7
Soybean meal%	28.5	28.0	28.0	28.0
Concentrated Protein%	6	6	6	6
Wheat %	15	15	15	15
Sun flower seed oil %	3	3	3	3
Salt%	0.3	0.3	0.3	0.3
Parsley %	0	1	0	0
Celery %	0	0	1	0
Cress %	0	0	0	1
Total	100	100	100	100

The chemical composition and nutritional values of vegetable feed additives including of parsley, cress and celery as shows in Tables 2 and 3 (Al–aswaad 2000).

Broilers housing conditions

Broilers were reared in accordance with the management guidelines recommended for the Ross strain. Feed and water were supplied ad libitum, and a continuous lighting program of 24 h per day was maintained. House temperature and vaccination schedules were adjusted according to standard recommendations for the different stages of broiler growth. Throughout the experimental period, birds were kept on deep litter under identical housing and management conditions. Environmental parameters, including ambient temperature and relative humidity, were monitored and recorded three times daily at 07:00, 12:00, and 17:00 h. Measurements were taken at bird level, corresponding to the height of the main body mass above the floor.

Table 2. Composition of parsley and cress

Parsley (per 100 g)	
Material	Quantity
Energy	315 kcal
Energy	1316 KJ
Water	20.5g
Protein	22 g
Carbohydrate	42 g
Sugar	0
Fat	4 g
Saturated	0
Monounsaturated	1.5 g
Polyunsaturated	1.5 g
Cholesterol	0
Fiber	10.5 g
Vitamin A	0
Vitamin B1	0.2 mg
Vitamin B2	1.2 mg
Vitamin B6	1 mg
Vitamin B11	0
Vitamin B12	0
Vitamin C	120 mg
Vitamin D	0
Sodium	450 mg
Potassium	3800 mg
Calcium	350 mg
Phosphor	0
Iron	95 mg
Magnesium	0
Copper	0
Zinc	0
Cress (per 100 g)	
Energy value	445 kcal
Crude protein	23.3 g
Available carbohydrates	33.6 g
Total lipid content	23.7 g
Omega-3 fatty acid share	32.18 %
Total dietary fibre	8.3 g

Productive parameters

Body weight

At 42 days of age, the final body weight was recorded by individually weighing the broilers after an overnight period, using a scale with a precision of ±5 g. Before the experimental diets were assigned, the groups were comparable in terms of initial body weight, with an average of approximately 41 g per bird. Live body weight (LBW) was determined at 15 days of age and at final day of age by recording living weight of individual broilers.

Body weight gain (g)= Final body weight - body weight at 15 days of age

Feed intake

Every week, the amount of feed consumed by each pen or replicate was documented and measured till the end of the feeding periods (42 days).

Feed Conversion Ratio (FCR)

Broilers were monitored daily, and any mortality was recorded along with the date and corresponding body weight before removal. The feed conversion ratio (FCR) was determined for each experimental period by dividing feed intake (FI, g) by body weight gain (BWG, g). In the calculation of FCR, the body weights of birds that died during the trial were included. The final FCR value was calculated at 42 days of age.

Slaughter outputs

At 42 days of age, marking the end of the trial, one bird with body weight representative of the group was selected from each replicate within every treatment and slaughtered for carcass evaluation. The relative weights were determined for the hot carcass, whole carcass including edible organs but excluding the head, carcass without edible organs and head, and the principal commercial cuts (breast, thigh, back, wing, and neck). In addition, the weights of edible offal (liver, heart, and gizzard) were recorded.

Statistical analysis

The experiment was arranged using a completely randomized design comprising four treatment groups. Data obtained from all trials were analyzed by analysis of variance (ANOVA) in accordance with the assumptions of a completely randomized design. Mean comparisons were performed using Duncan's multiple range test. Statistical significance was established at $P \leq 0.05$ for most variables. All statistical analyses were conducted using SPSS software (version 28 for Windows).

Table 3. Composition of 100g of celery.

Nutrient / Component	Quantity per 100 g	Contribution to Daily Intake (%)
Energy	14 kcal	-
Total lipid	0.2 g	0
Sodium	80 mg	3
Total carbohydrate	3.0 g	1
Dietary fiber	1.6 g	6
Sugar	1.3 g	0
Protein	0.7 g	1
Vitamin D	0 µg	0
Calcium	40 mg	3
Iron	0.2 mg	1
potassium	260 mg	6

Results and discussion

Chick's performance

Table 4 shows significant differences (P≤0.05) among all treatments (C, T1, T2, T3) for productive performance including of LBW at 15 days and final age 42 days, BWG, FI, and FCR. The highest final LBW was observed in T1, followed by T2, and the highest BWG was observed in T2, followed by T1 while the highest FI was recorded in C. This can be attributed to the role of coenzyme content in plants, including minerals and vitamins (as indicated in tables 2 and 3), which enhanced the broiler' appetite. Additionally, ascorbic acid, a component of the plants, acted as a blood cleanser.

These results align with the findings of Metwally (2023a), who reported that body weight, BWG, and FCR were significantly (P<0.05) improved in quail broilers fed diets containing 15 g/kg blends of parsley and watercress powder at 28, 35, and 45 days of age compared to the control. Conversely, Metwally (2023b) found no significant differences (P>0.05) in body weight of quail broilers due to the main effects of either celery or cinnamon over the experimental period, except at 28 days of age. Nonetheless, broilers fed basal diets supplemented with 6 g/kg celery achieved the highest body weight compared to other levels and the control group. These findings agree with the current study, which also indicates that no significant differences (P>0.05) in BWG were observed throughout the experimental period due to the main effects of either celery or cinnamon, except during the period from 0 to 4 weeks of age for celery and 0 to 5 weeks of age for cinnamon. At these ages, broilers fed the highest level of celery (basal diet + 6 g/kg feed) achieved the highest body weight compared to other treatments. The weight gain increase among broiler growth performance, fed by mountain celery, was also noticed in the study of Ahmadipour et al. (2018) explained to be due to the presence of naturally occurring polyphenols, including flavonoids. The content of polyphenols in celery supports growth promotion, high antioxidant level and immunocompetence (Ahmadipour et al. 2018).

FCR was the best in T1 and T2, which is an expected result due to the formula used for its calculation. Jawad and Al-Himdany (2019) reported in their study that supplementing broiler diets with 1% and 2% powdered parsley leaves resulted in no significant differences in body weight, BWG, weekly or cumulative feed consumption, and FCR compared to the control during most age periods. However, the antibacterial and antifungal properties of the metallic components in parsley leaves were found to enhance broiler health, positively impacting production performance (Zhang et al. 2006). It is worth noting that the metal content in parsley leaves may partially originate from environmental contamination, such as polluted soil or water sources, which could influence the observed effects and raise concerns about the potential accumulation of heavy metals in the food chain (Mitic et al. 2015).

Metwally (2023b) found no significant differences (P>0.05) in FCR due to the main effects of celery, cinnamon, or their combinations throughout the experimental period. However, broilers fed the highest levels of either celery or cinnamon achieved the lowest FCR compared to other treatments. Similarly, Saed et al. (2018) reported no significant differences in the final body weight of male broiler breeders fed diets supplemented with ginger or crushed celery seeds (2.5 and 5 g/kg of basal diet) during the experimental period (24–36 weeks of age). While the studies show no significant differences for the overall effects of these dietary supplements on performance metrics like FCR or final body weight, specific doses or conditions may still yield beneficial outcomes. This highlights the potential importance of optimizing supplementation levels to achieve desired effects, though more research is needed to confirm consistent benefits.

Hassan and El Shoukary (2019) found that supplementing broiler diets with cress seeds positively impacted body weight, weight gain, and feed intake. Similarly,

Nada (1999) reported that adding small amounts of cress seeds to layer rations improved body weight. Additionally, Shawle et al. (2016) observed that broilers fed diets containing 1.5% cress seeds achieved greater BWG and FI compared to the control group. These results collectively indicate that cress seeds are a promising natural supplement for improving poultry productivity.

Table 5. Impact of supplementation three type of vegetable on carcass characteristics (g) of broiler.

Treatments	Weight of total carcass	Weight of total carcass with edible part without head	Weight of carcass without edible parts and head
C	2668.57 ± 0.61b	2594.89 ± 1.03b	2357.16 ± 1.38b
T1	2566.20 ± 1.24d	2485.85 ± 1.47d	2204.16 ± 2.55d
T2	2647.95 ± 0.83c	2566.64 ± 1.39c	2310.50 ± 1.29c
T3	2756.92 ± 1.39a	2686.47 ± 1.24a	2383.00 ± 4.24a

Within the same column, means bearing different superscript letters indicate statistically significant differences ($P \leq 0.05$). Data are presented as mean ± standard error (SE).

Carcass characteristics

Table 5 observed significant differences (P≤0.05) for weight of total carcass among treatments and this harmonic reflect on total weight of carcass with edible and without edible parts, this can be attribute to the weight of origin weight of live body weight (14). The findings of the current study are consistent with those reported by Metwally (2023a), who observed that broilers receiving the control diet exhibited the highest carcass yield (71.71%). However, a comparable value (69.52%) was recorded in birds fed a dietary mixture containing parsley and watercress. In contrast, Hassan and El Shoukary (2019) indicated that the dressing percentage did not show any significant difference between control and groups fed Cress seeds 0.5%, 1% and 1.5%. Additionally, Metwally (2023b) showed that no significant differences due to the main effects of celery or cinnamon on carcass criteria except for dressed percentage of quail. However, broilers fed the basal diet supplemented with celery seeds (3 or 6g/kg feed) or cinnamon (4 g/kg feed) had the best dressed percentages than control broilers. Furthermore, Shawle et al. (2016) indicated that the slaughter weight, dressed weight, eviscerated weight, eviscerated percentage, carcass weight, and heart, liver, gizzard and kidney percentages were not significantly different among treatments.

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Main cuts properties

Table 6 observed that significant differences (P≤0.05) for all main carcass cuts, higher value was in T3, T3, C, T2 and T3 for breast, thigh, back, wing and neck respectively. The present findings are in line with those reported by Shawle et al. (2016), who demonstrated that the inclusion of varying levels of garden cress (GC) in broiler diets significantly influenced the proportions of breast, thigh, drumstick, combined thigh and drumstick, as

well as abdominal fat. Broilers receiving 0.75% GC showed higher breast and thigh yields compared with those fed 2.25% GC; however, these values did not differ significantly from birds given 0% or 1.5% GC. A lower drumstick percentage was observed in the control group (0% GC) relative to the other dietary treatments. Differences in neck percentage among treatments were statistically significant, except between the control and T3 groups. Shawle et al. (2016) indicated that the eviscerated weight and eviscerated percentage, were not significantly different among garden cress treatments.

Table 6. Impact of supplementation three types of vegetable on main carcass cuts (g) of broiler.

Treatments	Breast	Thigh	Back	Wings	Neck
C	730.98 ± 0.82d	615.30 ± 0.50b	528.50 ± 40.04a	170.24 ± 0.07c	104.08 ± 1.62a
T1	770.53 ± 050c	561.83 ± 3.46d	401.25 ± 2.63d	202.23 ± 8.43b	85.18 ± 0.56b
T2	775.08 ± 0.22b	570.08 ± 0.15c	488.725 ± 0.98b	220.23 ± 0.26a	74.70 ± 0.49c
T3	834.83 ± 0.55a	624.55 ± 1.03a	423.50 ± 16.38c	204.75 ± 0.96b	105.15 ± 0.82a

Within the same column, means bearing different superscript letters indicate statistically significant differences ($P \leq 0.05$). Data are presented as mean ± standard error (SE).

Giblets properties

Table 7 shows higher value in T3, T1, and C for liver, heart, and gizzard respectively this is related of developing enzymes and contain of each plant to effect of secretion digestion enzymes. The present study didn't agree with Hassan and El Shoukary (2019) who indicated that the liver weight did not show any significant difference between control and groups fed Cress seeds 0.5%, 1% and 1.5%. However, the result agrees with the weight of gizzard increased significantly ($P \leq 0.05$) in 1.5% Cress seeds group compared with other groups, and disagree with noted that addition of Cress seeds to broiler diets significantly decreases the heart weight. In contrast, Metwally (2023a) reported that broilers receiving a dietary mixture of parsley and watercress powder exhibited the highest gizzard percentage compared with both the control group and the other experimental treatments. Furthermore, Metwally (2023b) indicated that the combination between celery and cinnamon, broilers fed (basal diets+6 g celery/kg feed+4 g cinnamon/kg feed) had the best values for heart and dressed% compared to other treatments. Also, broilers fed (basal diets+6 g celery/kg feed) had higher liver percentage than other treatments. Gizzard% exhibited the highest value in broilers fed (basal diet+3 g celery/kg feed). Shawle et al. (2016) indicated that the heart, liver, gizzard and kidney percentages were not significantly different among garden cress treatments.

Table 7. Impact of supplementation three types of vegetable on edible parts (g) of broiler.

Treatments	liver	heart	gizzard
C	75.32 ± 0.48d	21.01 ± 0.9d	54.37 ± 0.42a
T1	78.31 ± 0.46c	24.73 ± 0.25b	51.21 ± 0.23b
T2	80.05 ± 1.58b	21.89 ± 0.10c	42.51 ± 0.50d
T3	84.89 ± 0.91a	28.08 ± 0.45a	45.18 ± 0.63c

Within the same column, means bearing different superscript letters indicate statistically significant differences ($P \leq 0.05$). Data are presented as mean ± standard error (SE).

Conclusions

Our results indicate that the use of fresh parsley, celery, and cress significantly enhances chick performance by promoting digestive system development and increasing enzyme activity. Additionally, incorporating these plants into feed is economically advantageous, as it leads to faster weight gain within a shorter breeding period. Furthermore, the use of these plants resulted in an improved FCR. The inclusion of fresh parsley, cress, and celery as dietary additives is recommended. We suggest incorporating these plants into broiler diets to enhance meat production.

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