Impact of supplementation three types of vegetable in Broiler diet on chicken meat: chemical composition

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Abstract

The impact of dietary additive including of parsley, celery and cress on quality of chicken meat was the aim of this study. 100 chicks (at 14 -day old) were divided on floor pens into 4groups, equally. First group was control (C) by using stander diet (without any additive), other three groups including of T1, T2 and T3 were fed with adding 10 gm of parsley, celery and cress per kg of diet, respectively. 5 broilers/group were slaughtered and the caresses were dissected. Basic chemical analysis and cholesterol were determined for breast, thigh and liver. Supplementation of vegetables dietary additive not had significantly impact on chemical composition, except positively influence on cholesterol content in thigh of chickens.

Keywords: *feed; chicken; meat; fat, cholesterol; protein*

Introduction

Worldwide consumption of poultry meat between 2011 and 2021 more than doubled, rising from about 69 Mt to almost 128 Mt with an average growth of ~3% per year (Dohlman et al., 2022). There are many factors that contribute to the popularity of poultry consumption such as its short production cycle (35–42 days), low cost, and high nutritional value and highly digestible. Additionally, its consumption is not restricted by religious beliefs, making it widely accepted among meat-eating populations globally (European Commission 2021; Serra et al. 2024). Natural plant supplements are gaining popularity in poultry diets due to their beneficial effects on poultry health, as well as their ability to improve meat quality, enhance antioxidant properties, and influence oxidative processes (Cristo et al. 2022). Lipid oxidation has a direct impact on meat quality, particularly in chicken meat, which is more prone to oxidative processes due to its high content of polyunsaturated fatty acids (PUFAs) (Delles et al. 2014). Plant extracts as animal feed additives are a promising alternative to antibiotic growth promoters (AGPs) as they are natural, residue-free, and offer health, antimicrobial, antioxidant, and digestive benefits. Unlike synthetic antioxidants, which may pose carcinogenic risks, plant-based options as feed additive are considered safer for use in food production (Cristo et al. 2022). Research shows that the Apiaceae family, which includes plants like carrots, parsnips, celery, fennel, coriander, parsley, dill, anise, and lovage, is known for its medicinal value and abundance of bioactive compounds (Bas-Bellver et al., 2023; Blando et al., 2021). Parsley (*Petroselinum crispum*), a widely cultivated herb from the Mediterranean region, belongs to the Apiaceae family. Rich in zinc, β-carotene, vitamins A, B, and C, as well as essential minerals like iron and calcium, parsley is commonly used in cooking and valued for its health benefits. It contains active compounds such as flavonoids, vitamin C, myristicin, and apiol, which contribute to its antioxidant, anti-inflammatory, and antimicrobial properties

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(Alagawany et al., 2024). Celery (*Apium graveolens*) contains high levels of protein, fiber, and essential minerals. Its leaves are especially rich in choline, pantothenic acid, and rutin, which help boost resistance to infections (Weselek et al., 2021; Liu et al., 2020). Garden cress (*Lepidium sativum*) is a traditional medicinal plant widely used for both human health and livestock care. Its seeds, leaves, and roots are known for promoting bone healing and treating various conditions such as asthma, high blood pressure, and digestive issues. Rich in essential fatty acids (oleic and linolenic), antioxidants, tocopherols, and lignans, garden cress supports weight gain and improves nutrient digestibility, making it a valuable natural supplement (Shawle et al., 2016).

This study aimed to investigate how dietary inclusion of celery, parsley, and cress influences the quality attributes of chicken meat, with particular emphasis on its proximate composition and cholesterol levels

Materials and Methods

This study was carried out at Shaqlawa Technical College, Polytechnic University–Erbil. A total of 100 fourteen-day-old Ross 308 broiler chicks were randomly divided into four groups (25 chicks each), with five replicates per group (5 chicks per replicate). The basal diet was sourced from Erbil Feed Company in Qush Tapa, Erbil, based on specific nutritional requirements. Fresh vegetable additives—parsley, celery, and cress—were purchased from local markets in Shaqlawa. The four feeding treatments for the bird groups were organized as follows:

- **C (Control):** Standard basal diet with no additives
- **T1:** Basal diet supplemented with 10 g/kg of fresh parsley (*Petroselinum crispum*)
- **T2:** Basal diet supplemented with 10 g/kg of fresh celery (*Apium graveolens*)
- **T3:** Basal diet supplemented with 10 g/kg of fresh garden cress (*Lepidium sativum*)

The composition of the feed, including the basal diet and vegetable additives used in the experimental treatments, is presented in Table 1.

Table 1: Feed Composition of treatments.

Feed Ingredients	C	T1	T2	T3
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

Bird housing conditions

Broiler chicks were raised following Ross management guidelines. Feed and water were provided ad libitum, with continuous lighting (24 hours per day). Housing temperature and vaccination schedules followed standard recommendations for broiler rearing. Throughout the trial, all chicks were kept on deep litter under uniform environmental and technological conditions. Temperature and humidity (microclimate indicators) were monitored and recorded three times daily—at 7:00 am, 12:00 pm, and 5:00 pm—at the level corresponding to the birds' body height.

Slaughter outputs

At the end of the 42-day trial, one bird with similar body weight was selected from each replicate of the treatment groups for slaughter. Thigh muscles and liver were homogenized in order to chemical composition analyses.

Chemical composition of meat

The basic chemical analysis of the thigh and liver were determined and represented in percentage in the meat represented in g.kg.-1. Dry matter (DM) determined by using the thermal method (Al–aswaad 2000). Total nitrogen (crude protein) content was measured using the macro-Kjeldahl method, following the procedures outlined in ISO 5983-2:2009 for block digestion and steam distillation, and ISO 5983-1:2005 for the Kjeldahl technique, utilizing a LECO NS nitrogen analyzer (LECO Corporation, St. Joseph, MI). (Al–aswaad 2000). Total fat content was determined by the Soxhlet method (Al–aswaad 2000) standard method. Total ash content was measured in accordance with the ISO 5984:2022 standard method. Cholesterol levels were determined through Gas Liquid Chromatography (GLC) following the SYRBO Company's procedures for cholesterol analysis. These analyses were carried out at Mizda Private Medical Laboratory (Erbil, Iraq) for meat cholesterol estimation, and at Eliza Laboratory for veterinary assessments.

Statistical analysis

A completely randomized design with four treatments was used for the experimental setup and data analysis. All data were analysed using ANOVA suitable for this design, and mean differences were assessed using Duncan's Multiple Range Test. A significance level of $P \leq 0.01$ was applied for chemical parameters. Percentage data were transformed before analysis. All statistical evaluations were conducted using SPSS version 28 for Windows.

Results and discussion

Chemical composition

The data in Table 2 demonstrates the effects of various dietary treatments (C, T1, T2, T3) on the chemical composition of chicken tissues. For breast muscle, there were no significant ($P>0.05$) differences in dry matter, crude protein, total ash, or ether extract percentages across the treatments. However, significant differences were observed in cholesterol content, with treatment C having the highest cholesterol level (58.23 mg/100g) and treatment T3 the lowest (34.63 mg/100g), indicating a potential impact of the diet on cholesterol deposition in the muscle. Other studies have reported varying cholesterol levels in chicken meat based on dietary fat sources. For instance, a study found cholesterol levels in breast meat ranging from 37.41 to 79.9 mg/100g, depending on the diet (Milićević et al. 2014).

In thigh muscle, dry matter percentage varied among treatments, with treatment T3 having the highest value (26.65%) and treatment C the lowest (24.85%). Crude protein and total ash percentages remained relatively constant across treatments. The cholesterol content in the thigh muscle decreased from treatment C (64.90 mg/100g) to T3 (45.05 mg/100g), similar to the breast muscle results, suggesting that dietary treatments may influence cholesterol levels in different tissues. For the liver, dry matter percentages were fairly consistent across the treatments. Crude protein content in the liver varied slightly, with treatment T3 showing the lowest protein level (15.78%). Ether extract and total ash content did not exhibit significant differences. However, the cholesterol content in the liver varied between treatments, with treatment T3 having the lowest (49.20 mg/100g) and T1 the highest (59.58 mg/100g), showing some impact of Parsley on cholesterol deposition in the liver.

The lower cholesterol content findings in broilers fed by feeding formula containing plant extract (parsley, celery and cress) is in agreement with the findings of Metwally (2023) who observed that incorporating medicinal blends (a mixture of parsley and watercress) significantly affected plasma triglycerides, HDL, LDL, and VLDL levels in Japanese quails. Furthermore, Bahnas et al. (2009) demonstrated that supplementing growing quails with varying amounts of parsley or its by-products, significantly influenced calcium, cholesterol, and triglyceride levels. Though, there are also previous publications findings that parsley addition did not affect cholesterol level (Alagawany et al. 2024). The lower cholesterol level can be explained also by the fact that dietary fiber in plants binds bile acids in the gastrointestinal tract, enhancing their excretion. This reduces cholesterol reabsorption and forces the liver to utilize circulating cholesterol for bile acid synthesis (Naumann et al. 2020). Antioxidants such as vitamin C and polyphenols in celery and cress reduce oxidative stress, which is linked to lipid peroxidation and cholesterol accumulation in tissues (Ahmadipour et al. 2018). Bioactive compounds like flavonoids and ascorbic acid enhance lipid metabolism by supporting enzymatic activity, as evidenced in the reduced cholesterol levels in broiler tissues (Tan et al. 2022).

Table 2: Impact of supplementation three types of vegetable on chemical composition of breast, thigh and liver of chickens.

Attribute	Dietary treatments			
	C	T1	T2	T3
	Breast muscle			
Dry matter %	26.10±0.18	26.22±0.58	25.88±0.20	24.00±0.44
Crude protein %	20.41±0.14	20.55±0.24	20.61±0.93	20.53±0.26
Ether extract %	1.54±0.33	1.76±0.55	1.22±0.46	1.26±0.30
Total ash %	1.19±0.01	1.19±0.04	1.21±0.04	1.21±0.04
Cholesterol mg.100g-1	58.23±0.36^{a}	45.63±4.46^{b}	39.88±0.83^{c}	34.63±1.37^{d}
	Thigh muscle			
Dry matter %	24.85±1.03	26.51±1.06	25.63±0.94	26.65±0.29
Crude protein %	17.40±0.31	17.32±0.29	17.42±0.44	17.45±0.30
Ether extract %	4.23±0.74	5.60±0.89	5.15±0.87	4.84±0.23
Total ash %	1.10±0.01	1.09±0.04	1.12±0.03	1.11±0.01
Cholesterol mg.100g-1	64.90±0.95^{b}	54.30±2.24^{a}	49.35±0.55^{a}	45.05±1.26^{c}
	Liver			
Dry matter %	25.69±0.97	26.34±0.97	26.27±0.34	26.23±1.12
Crude protein %	16.81±0.31	16.50±0.38	16.91±1.72	15.78±0.97
Ether extract %	3.15±0.27	3.22±1.08	3.06±0.32	3.09±0.39
Total ash %	1.356±0.01	1.38±0.017	1.37±0.02	1.36±0.04
Cholesterol mg.100g-1	51.70±3.40	59.58±2.34	50.65±1.07	49.20±0.79

Values in the same row with different superscript letters ($^{a, b, c, d}$) are significantly different ($P \leq 0.01$). Data are presented as mean ± standard deviation (S.D.).

Conclusions

These results are part of a broader study that was divided into three separate research components to meet the publication requirements. The study aimed to examine the effects of adding fresh parsley, cress, and celery to the diet on the chemical composition of chicken meat. Enhancing meat quality through the use of dietary additives in animal feed is a common practice. The inclusion of vegetable-based dietary additives resulted in reduced cholesterol levels without significantly affecting the basic chemical composition of broiler meat.

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