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# Influence of onion (*Allium cepa* L.) supplementation on physio-chemical composition and lipid profile of broiler meat

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## Abstract

The poultry industry profoundly impacts food security and daily protein intake provision. The employment of various medicines in their husbandry has also threatened consumers' health. Hence, new organic and inert substance are investigated to avoid the potential threat to human health. Therefore, a study was conducted to determine the effect of onion on performance, lipid profile, chemical composition, and acceptability of broiler meat. Dietary supplementation of onion given at the dose of 4.5, 5.0, and 5.5 g/kg of feed exerted a substantial effect ($P< 0.05$) on the proximate chemical composition of leg and breast meat. Protein percentage was increased, while the fat percentage decreased in meat significantly ($P<0.05$) in treated groups for leg and breast. Moisture and dry matter content of meat were not influenced by onion supplementation. Feed supplementation of onion substantially ($P<0.05$) reduces water holding capacity in treated groups compared to non-treated. Onion powder did not exert any significant effect ($P>0.05$) on iron content, ash, and breast and leg meat pH values. Internal fats were ($P<0.05$) significantly decreased in treated groups compared to the control. Onion powder at a dose rate of 4.5g, 5g, and 5.5 g/kg of ration in broilers had a significant effect ($P< 0.05$) on total cholesterol. Total cholesterol was decreased in treated groups of meat samples compared to the control. Onion powder supplementation has a significant ($P< 0.05$) effect on meat's fatty acid profile. Fatty acids, namely mono and polyunsaturated fatty acids like Oleic acid and linoleic acid (LA), were increased significantly in meat compared to the control group. Saturated fatty acid (SFA), i.e., palmitic acid, was notably ($P<0.05$) decreased in treated groups B, C, and D as compared to control.

## Introduction

Poultry is one of the major stakeholders for food security that fulfills the daily protein intake needs worldwide. In poultry, the extensive husbandry practices are accompanied by various vaccination schedules and medications [1]. Especially in broiler meat, the residues of supplemented medicines viz antibiotics, growth promotors, anti-stressors, etc., can be transmitted to consumers with severe health hazards. Alternative strategies viz organic and phytochemical are supplemented in poultry ration to circumvent these hazards. For instance, ginger, turmeric, garlic, aloe vera, and barberry have been augmented in poultry feed, which improves the health status of the birds and improves the meat quality parameters [2, 3]. Similarly, *Moringa oleifera* extracts feeding supplementation has been reported with growth promoters, antioxidants, immune enhancers, and hypo-cholesterol effect in chickens [4]. In addition, these phytochemicals pose subtle to no potential threats to human health [5].

Likewise, onion has long been used in the medicine and food industry. The bulb is rich in different pharmacologically active compounds known for antioxidant, antiviral, antimicrobial, and antifungal properties[6, 7]. Due to different growth conditions, harvest methodology, and storage conditions, onion species have distinct polyphenol levels. Onion has so many valuable medicinal applications because of the nutrients, vitamins, minerals, and organic compounds contained in them, including the presence of sulfuric compounds and quercetin in traces of the essential oils [8, 9]. Onions also have mineral components such as calcium, magnesium, sodium, potassium, selenium, and phosphorus, and they are a good source of vitamin C, vitamin B6, and dietary fiber [10-12]. The dietary onion extract is known to enhance the immunoglobulin level and the antioxidant activity of meat [13]. The acid and base pH, water retention ability during and before cooking, acceptability of meat, and meat flavor-enhanced after herb extract mixture (HEM) were included in the feed [14]. Therefore, this study is conducted to evaluate the effect of onion powder on the chemical composition, quality, and fatty acids of broiler meat.

## Material and Methods

***Experimental design***

Broiler chicks total (n = 256) were randomly assigned to different treatment groups using a completely randomized design. Broiler chicks of almost the same weight, age, breed, the sex were obtained from a local company. These chicks were divided into four groups A, B, C, and D, supplemented with onion feed. Each group consists of four replicates (16 chicks/replicate). Group A was the non-treated group, while other groups were treated, supplemented with three different doses of onion feed (Group B: 4.5, C: 5, and D: 5.5 gram/kg of feed). Chicks were raised in the open-sided shed in a wooden pen. Standard environmental conditions were provided, and all the utilities like feeding and drinking utensil were placed in a wooden pen. The experimental trial was continued for 42 days. The main ingredients of the feed used are provided in **Table 1**.

All animal/bird-involved experiments were approved and performed under the supervision of the departmental animal care committee of the agriculture university Peshawar.

***Preparation of onion powder***

A red variant of onions was purchased from the local market. The onion bulb was sliced into pieces of 5 to 10 mm thickness by following a conventional peeling method at the industry and domestic levels [15]. The dry outer scale was removed twofold on the top bottom of the onion. Two methods dried the samples of the onion bulb along with the top-bottom. The small pieces of onion were air-dried using an air current for 12 h and placed on paper to absorb the moisture. These samples were then shifted to the incubator at a temperature of 40 ℃ for the next 12 h and blended into powder using Marlex Excella electric blender. The samples were stored in airtight containers before analysis. The chemical composition and mineral content of *Allium cepa* L. have been determined by the previously described method [11].

***Determination of birds' performance***

Live body weight was recorded every week. On the day first, birds were weighed, and then on the last day of every week. Bodyweight gain was recorded by subtracting initial weight from final live body weight. Total live body weight was recorded at the end of the study. Freshwater was provided ad libitum. The water given was subtracted from the water left on the next day to record the water consumption. The ration was given to each bird in a wooden pen as required daily and calculated by subtracting the given ration from

**Table 1:** Constituents and composition of the basic ration

| Ingredients (g/kg of diet) | Starter | Finisher |
|---|---|---|
| Soybean meal (480 g CP/kg) | 275.0 | 170.0 |
| Sunflower meal 350 g CP/kg) | 110.0 | 110.5 |
| Wheat | 99.0 | 331.0 |
| Wheat bran | - | - |
| Meat-bone meal | 65.0 | 49.5 |
| Vegetable oil | 73.9 | 73.5 |
| Limestone | 13.5 | - |
| Mineral-vitamins premix[1] | 3.5 | 3.5 |
| Sodium chloride | 3.1 | 2.5 |
| L-lysine | 0.4 | 0.1 |
| DL-Methionine | 1.6 | 1.7 |
| **Calculated chemical composition (per kg of diet)** | | |
| ME (MJ) | 13.2 | 13.4 |
| Crude Protein (g) | 231.2 | 189.8 |
| Calcium (g) | 15.0 | 8.0 |
| Available phosphorus (g) | 5.0 | 3.9 |
| Lysine (g) | 12.0 | 8.5 |
| Methionine (g) | 5.6 | 5.2 |
| Methionine + cystine (g) | 9.3 | 8.4 |
| Sodium chloride (g) | 3.4 | 2.9 |

**Note:** d-biotin 0.05 mg; vitamin B12 0.03 mg; vitamin B2 6 mg Mn 80 mg; Zn 60 mg; vitamin B6 5 mg Fe 60 mg; calcium-d-pantothenate 10 mg niacin 25 mg; vitamin E 50 mg; Iron 5 mg; vitamin B1 3 mg Cu 5 mg; vitamin D3 2 400 IU; vitamin A 12 000 IU; Co 0.2 mg; I 1 mg; Se 0.15 mg; vitamin K3 4 mg; choline chloride 200 mg; folic acid 1 mg / kg of ration.

denied on the following day. The total feed given was measured at the end of this study on day 42. Different parameters like feed conversion ratio (FCR), performance traits, weight gain, and daily and weekly feed intake were measured accordingly.

### *Vaccine therapy*

Total birds per group were vaccinated against ND, IB on day 7$^{th}$, and IBD on day 12$^{th}$. The Birds were given a booster dose of the IBD vaccine on the day 18$^{th}$ and ND and IB on day 24$^{th}$ as per schedule. During the whole experiment, birds were checked for mortality, and dead birds were removed to determine the etiology of mortality.

### *Chemical composition of meat*

On day 42 of the trial, two birds were randomly selected from each replicate and sacrificed to compare the carcass characteristics using the standard procedure [16]. For this purpose, 100 grams of meat samples (leg and breast) were collected at 42 days of the age of the broiler. Crude fat, crude proteins, dry matter, pH, ash, and moisture content were determined. Determination of dry matter (DM), crude protein (CP), ether extract (EE), and ash contents in meat samples were performed through proximate analysis in VRI Peshawar according to the AOAC methods [17]. The acid-base pH was evaluated by directly inserting a digitally corrected pH meter at pH 4 and 7 at normal environmental temperature and inserted into the breast and leg muscles [18]. Every three replicates were analyzed, and samples were collected 2 hours after slaughter. The moisture content of chicken leg and breast muscles was evaluated as described elsewhere [19]. Briefly, the 100 g of sample was dried out at 60 ºC for 72 h in the oven until a constant weight was recorded. Water holding capacity in the meat sample was also performed by following previously published methodology [20]. In brief, the water holding capacity of meat was determined by placing 1 g of breast meat sample between two filter papers (9 cm Whatman No 1) and then enclosed in between two 10.2 x 10.2 cm Plexi glasses and pressed between two jaws of a vice with approximately 35.60 kg/cm3 for 1 minute. The free water and pressed meat samples were measured using the grid method, while the percent of free water was calculated based on weight and moisture content.

Water holding capacity was calculated as:

WHC = 100-(Aw-Am) × 9.47 × 100 Wm × Mc

Where: Aw = Area of water released from meat samples ($cm^2$), Am = Area of meat samples ($cm^2$), Wm = Weight of meat (g), Mc = Moisture content of meat samples (%) and 9.47 = Constant factor.

### *Lipid profile of broiler meat*

At the end of the six weeks of the experiment, two birds were randomly selected from each replicate and

sacrificed to compare the carcass characteristics using the standard procedure [21]. For this purpose, 100 grams of meat samples (leg and breast) were collected at 42 days of the age of the broiler. Fatty acid and total cholesterol of meat samples (breast and leg) were determined. Lipid profile includes the determination of total cholesterol and three types of fatty acids, namely mono and polyunsaturated fatty acid and saturated fatty acid in the breast (Pectoris major) and leg (Longus major/Peroneus fibularis) muscles was determined by gas-liquid chromatography (NUCON GC 5765, Nucon Engineers, India) [22]. To determine total cholesterol, the meat samples were collected from the leg and breast region of the chicken. Total cholesterol was determined by Gas Chromatography (GC- FID). About 100 gm of the frozen sample was taken, and completely removed the external fat of the leg and breast muscles.

***Statistical Analysis***

Data on chemical composition (CP, DM, and EE) of meat, and lipid profile (meat quality) parameters, of broiler meat were statistically analyzed by applying analysis of variance (ANOVA). Statistical design (CRD) complete randomized design with 4 $R_x$ and 16 replicates and 16 birds per wooden pen/ replicate were applied. The data were analyzed through software, i.e., the SAS statistical package, and presented as mean±standard deviation (SD). A probability value <0.05 was considered significant.
Statistical model: $Yij = \mu + \alpha j + Eij$

## Results and Discussion

The data was recorded for proximate composition, i.e., crude protein, crude fats, moisture contents, ash, pH, dry matter, and water holding capacity of broiler leg and breast samples of meat. The data was also recorded for the lipid profile, i.e., meat samples' total meat cholesterol and fatty acid.

***Chemical composition of meat***

The addition of onion powder in feed exerted a substantial effect (P<0.05) on crude protein, as shown in **Fig. 1**. A 25 % significant increase in the content of crude proteins in breast meat was observed with group D, given 5.5 gm/kg of onion supplements. Likewise, a substantial increase (21%) in leg meat protein composition was also observed in group D compared to the control group. The other two groups (supplemented with 4 and 5 gm/kg) have also shown a significant uprise in protein composition in breast and leg meat samples with onion supplementation compared to control. The effects of onion powder supplementation on the proximate chemical composition of broiler chickens' meat (breast and leg) are illustrated in **Fig. 2 and 3** and tabulated in **Tables 2 and 3**. Statistical analysis showed that supplementation of dried onion as a feed additive exhibited a significant effect (P<0.05) on the chemical composition of meat, i.e., crude protein, crude fats, water holding capacity, and internal fats of leg and breast meat, while a non-significant effect has been observed on moisture content, dry matter (crude fibers), ash content percentage, pH values and iron content mg/gram of broiler meat. Onion supplementation increased the mean percentage of crude proteins in breast meat of treated groups as compared to control, i.e. (20.75± 0.50 in A, 23.75 ± 0.5 in B, 24.34± 0.23 n C and 24.95± 0.36 percent in group D). Similarly, the mean percentage of crude protein percentage in leg meat of groups A, B, C, and D was found as 16.5 ±0.49, 18.1 ±0.53, 18.825± 0.65and 19.7± 0.21, respectively, and presented in **Table 3**.
The addition of onion in the feed also exhibited a momentous (P<0.05) decrease of crude fats content in breast meat, as observed at 24.25± 1.70 in A, 20.50 ± 1.29 in B, 22.25± 1.03 in C, and 22.175 ±0.93 percent in group D. When compared, the different content of breast and leg meat, i.e., crude protein, moisture content, and water holding capacity in breast meat, was found with a high value as compared to leg meat. Similarly, crude fats, ash percentage, iron content, and pH values in leg meat were higher than in breast. In feed added onion groups internal fat content of breast meat were also reduced substantially (P<0.05). Onion powder in the broiler feed also decreased water holding capacity. The average WHC of breast meat was observed as 39.75 ± 0.57, 37.51±0.57, 35.65± 0.13, and 35.8075± 0.12 percent in groups A, B, C, and D, respectively. Supplementation of onion powder in feed exerted a significant effect (P<0.05) on the WHC of breast meat. Similarly, moisture percentage and iron content (Fe) were also increased non significantly, and average ash contents of fresh breast meat of broilers were 1.575 ± 0.33, 1.325± 0.15, 1.253± 0.32, and 1.123±0.16 in groups A, B, C, and D, respectively. The onion as a feed additive has a non-significant effect on the mineral content of breast and leg meat in B, C, and D treated groups.

**Table 2:** Effect of onion powder on the chemical composition of broilers breast meat

| Parameters Breast meat | Treatment | | | |
|---|---|---|---|---|
| | A | B | C | D |
| **Crude protein%** | 20.75$^{c}$± 0.50 | 23.75$^{ab}$ ± 0.5 | 24.34$^{a}$± 0.23 | 24.95$^{a}$± 0.36 |
| **Crude fat%** | 24.25 $^{c}$± 1.70 | 20.50 $^{ab}$ ± 1.29 | 22.25 $^{a}$ ± 1.03 | 22.175 $^{a}$ ±0.93 |
| **Dry matter%** | 28.25 ±0.95 | 27.25 ± 1.22 | 26.25± 0.14 | 27.5 ±0.12 |
| **Moisture content %** | 72.55 ± 1.19 | 73.05 ± 0.79 | 74.55 ± 0.5 | 73.025 ± 0.14 |
| **Water holding capacity%** | 39.75 $^{a}$ ± 0.57 | 37.51 $^{b}$ ± 0.57 | 35.65 $^{c}$± 0.13 | 35.8075$^{cd}$±0.12 |
| **Fats internal %** | 4.25 $^{a}$ ± 0.95 | 3.25 $^{b}$ ± 0.81 | 3.15 $^{bc}$± 0.23 | 3.225 $^{c}$ ±0.71 |
| **Ash** | 1.575 ± 0.33 | 1.325 ± 0.15 | 1.253 ± 0.32 | 1.123 ±0.16 |
| **Iron Fe mg/kg** | 4.362 ± 0.51 | 4.23 ±0.38 | 4.3625±0.21 | 4.4 1±0.34 |
| **pH value** | 5.73 ±0.18 | 5.575 ±0.27 | 5.645 ±0.13 | 5.675 ± 0.14 |

A – onion powder at dose rate of 0 g, B - 4.5g,C - 05g, D - 5.5 gm/ kg feed, a,b,c,d- means with different superscripts differ significantly (P ≤0.05).

**Table 3:** Effect of onion powder on the chemical composition of broilers leg meat

| Chemical parameters of leg meat (%) | Treatment | | | |
|---|---|---|---|---|
| | A | B | C | D |
| **Crude protein** | 16.5 $^{d}$ ±0.49 | 18.1 $^{bc}$ ±0.53 | 18.825 $^{c}$± 0.65 | 19.7 $^{a}$ ± 0.21 |
| **Crude fat** | 35.32 $^{a}$ ± 0.54 | 33.47 $^{b}$ ±0.45 | 32.4 $^{c}$±0.54 | 32.17 $^{cd}$± 0.87 |
| **Dry matter** | 30.45± 0.23 | 30.675 ±0.31 | 29.105 ±0.34 | 29.57 $^{a}$± 0.23 |
| **Moisture content** | 70.35 ±0.63 | 71.8± 0.43 | 71.45 ±0.91 | 71.9 ±0.47 |
| **Water holding capacity** | 31.575 $^{a}$± 0.40 | 27.132 $^{b}$ ±0.23 | 24.1 $^{c}$± 0.45 | 24.03 $^{cd}$ ± 0.13 |
| **Fats internal** | 9.05 $^{a}$ ±0.067 | 8.125 $^{b}$ ±0.095 | 8.225 $^{bc}$± 0.063 | 7.4 $^{d}$ ±0.083 |
| **Ash** | 8.525 ± 0.097 | 8.075 ± 0.091 | 8.75 ± 0.087 | 8.85 ±0.056 |
| **Iron Fe (mg/kg)** | 7.025 ± 0.032 | 7.2875 ±0.023 | 7.8125 ± 0.014 | 8.155 ±0.032 |
| **pH value** | 6.65 ± 0.012$^{a}$ | 6.575 ± 0.095 | 6.645 ±0.057 | 6.67 ±0.087 |

A – onion powder at dose rate of 0 g, B - 4.5gm, C - 05g, D - 5.5 g/ kg feed, a,b,c,d- means with different superscripts differ significantly (P ≤0.05).

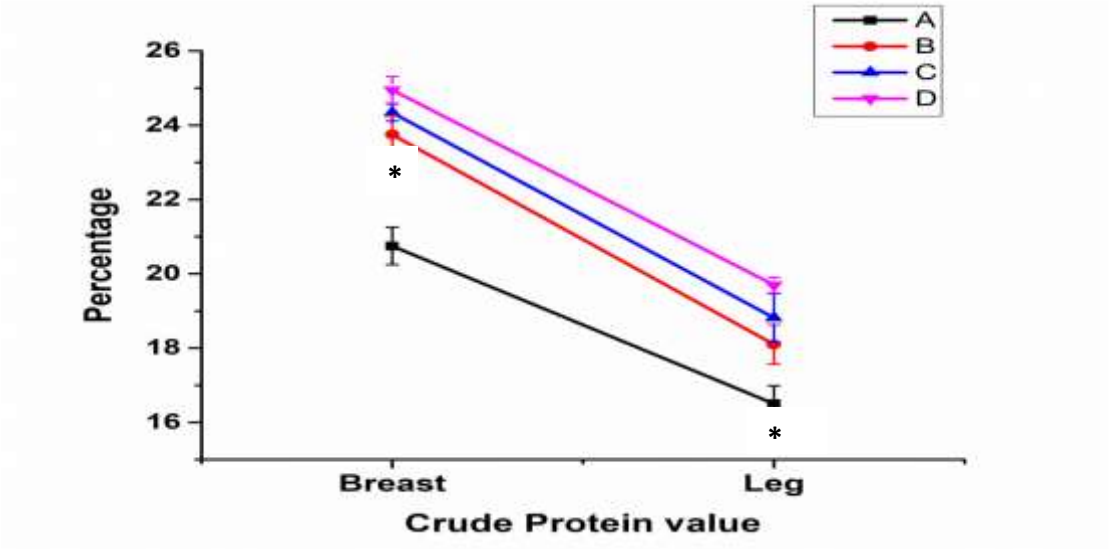


**Fig. 1:** The mean percent comparison of proteins between breast and leg meat samples with onion supplementation at distinct doses. Significant changes in protein composition are observed when supplemented with 4, 5, and 5.5 g/kg of onion compared to control. *P<0.05 is considered statistically significant.

Significant effects (P<0.05) of onion powder supplementation on crude proteins and fat percentage in broiler meat were observed. Similar to our findings, a study evaluated the effect of onion and garlic solution on carcass fats of broiler and showed a significant decrease in cholesterol and fats [23]. Previously it has also been reported that onion increased intestinal absorption of nutrients in the

broiler after being given different feed additives; while studying the pH value, they observed that cooking loss was significantly reduced with the supplementation of the additives in diet and unaltered moisture content was observed by supplementation of the herbal plant [24].

Our results also agreed with the previously reported study, which demonstrated the improved meat characteristics (water holding capacity, pH, acceptability) by including the different herbal plants [14]. Likewise, a similar analysis has been evaluated, which demonstrated that plant extract as a feed mixer enhanced the digestibility of the crude protein and other nutrients [25]. At the same time, another analysis showed a non-significant change in meat color after supplementation of onion powder in the diet of broilers [26]. The groups having onion showed lesser losses during cooking and high share values. A similar observation has been evaluated that the moisture content was not affected by garlic supplementation [27].

***Lipid profile (meat quality) parameters***

The effect of onion feed on the lipid profile of meat included total cholesterol, and three types of fatty acids in broiler meat were evaluated. The mean comparison of total cholesterol between breast and leg of boilers, supplemented with different onion concentrations (0, 4.5, 5, and 5.5 g/kg), is represented in **Fig. 4**. The effects of onion powder supplementation on the meat quality of broiler chickens are presented in **Table 4** and **Fig. 5**. A statistical analysis of the data showed a significant ($P<0.05$) effect of onion supplementation on the lipid profile of broilers meat. Unsaturated fatty acids, namely PUFA linoleic acid and MUFA oleic acid concentrations, were increased among the treatment groups with the increased concentration of onion powder. Total cholesterol levels and saturated fatty acid, namely palmitic acid, were decreased with the same pattern of UFA in meat. The mean oleic acid (Monounsaturated fatty acid) mg/100-g meat were 35.04± 0.73 in A, 38.91± 0.42 in B, 36.88± 0.79 in C, and 37.40± 0.98 in group D. Maximum USFA was observed in group B as shown in **Fig. 5**.

Similarly, the effect of onion powder given to groups B, C, and D was constructive ($P< 0.05$) on the linoleic acid of broiler meat. Mean weight in mg/100 gram and SE of PUFA in treated groups were 9.81± 0.61, 13.86 ±0.49, 15.78±0.77, and 14.23 ±0.155 in groups A, B, C, and D of broiler meat, respectively. The mean weight of linoleic acid (polyunsaturated fatty acid) is represented in **Table 4**. Onion supplementation on saturated fatty acid, namely palmitic acid, has a significant effect, and dietary supplementation of onion had a significant effect on the SFA of the broiler**.** The average weight in mg per 100g of meat of saturated fatty acid was (29.72±0.67, 24.26± 0.08, 22.17±0.50, and 22.52± 0.550) in four treated groups of broilers. It was observed that palmitic acid was decreased among the treated groups as the concentration of *Allium cepa* powder was increased.

Similarly, onion exhibited a significant ($P<0.05$) effect on total cholesterol of meat samples and decreased total cholesterol of breast meat, and the average weight in mg per 100 g of fresh meat was 68.58 ±1.17,62.61±1.21,62.30± 0.69, and 60.71±1.44 in groups A, B, C, and D respectively. Onion powder supplementation in feed decrease the total cholesterol level in leg meat. The mean cholesterol was found to be 88.78± 0.62, 79.48± 0.57, 81.28 ±0.87, and 78.28± 1.38 mg in treated groups B, C, and D, which was less as compared to control group A. The statistical analysis revealed that adding onion powder to feed exerted a significant effect ($P<0.008$) on the meat cholesterol level in birds, as shown in **Fig. 6**. The cholesterol present in leg meat was more than that found in breast meat.

Significant effects ($P<0.05$) of onion powder supplementation were observed on the lipid profile of the meat. Our outcomes are in line with the previously reported study [28]. They investigated the better effect after including growth promoters including onion, garlic, and vitamin E on broiler chicken meat. They studied that 2% of onion solution significantly decreased pH and cooking loss of frozen meat. They also studied the effect of garlic, onion, and vitamin E solution, which showed a significant reduction in saturated fatty acid (palmitic acid) and increased unsaturated fatty acid in meat. The supplementation of onion enhances light and yellow color and decreases the redness in muscles after adding onion, garlic, zinc bacitracin, and Vit. E group with a significant correlation in terms of color and pH. [29]. The reduction in the red color of meat due to the supplementation of hot pepper may be due to the oxygen consumption and meat myoglobin reduction system.

In this study, the positive impact of onion on feed utilization was observed. The digestibility of dry matter, crude protein, and ether extract were improved with mixed onion powder in treatment groups compared to the control. These results are in line with earlier research which reported that plant extract in

**Table 4:** Effect of onion powder on broilers' meat quality (lipid profile).

| Lipid Profile Parameters mg/100-gram meat | Treatment | | | |
|---|---|---|---|---|
| | A | B | C | D |
| **MUFA Oleic acid** | 35.04 $^{c}$± 0.73 | 38.91 $^{a}$ ± 0.42 | 36.88 $^{b}$ ± 0.79 | 37.40 $^{ab}$± 0.98 |
| **PUFA linoleic acid** | 9.81 $^{d}$± 0.61$^{d}$ | 13.86 $^{c}$ ±0.49 | 15.78 $^{a}$ ±0.77 | 14.23 $^{b}$ ±0.155 |
| **SFA Palmitic acid** | 29.72 $^{a}$ ±0.67 | 24.26 $^{b}$± 0.082 | 22.17$^{cd}$±0.50 | 22.52$^{c}$± 0.550 |
| **Total Cholesterol breast** | 68.58 $^{a}$ ±1.17 | 62.61 $^{b}$±1.21 | 62.30$^{bc}$± 0.69 | 60.71$^{d}$±1.44 |
| **Total Cholesterol leg** | 88.78 $^{a}$ ± 0.627 | 79.48$^{c}$± 0.57 | 81.28$^{b}$ ±0.87 | 78.28 $^{d}$± 1.38 |

A – onion powder at dose rate of 0 g, B - 4.5g, C - 05g, D - 5.5 g/ kg feed, a,b,c,d- means with different superscripts differ significantly (P ≤0.05).

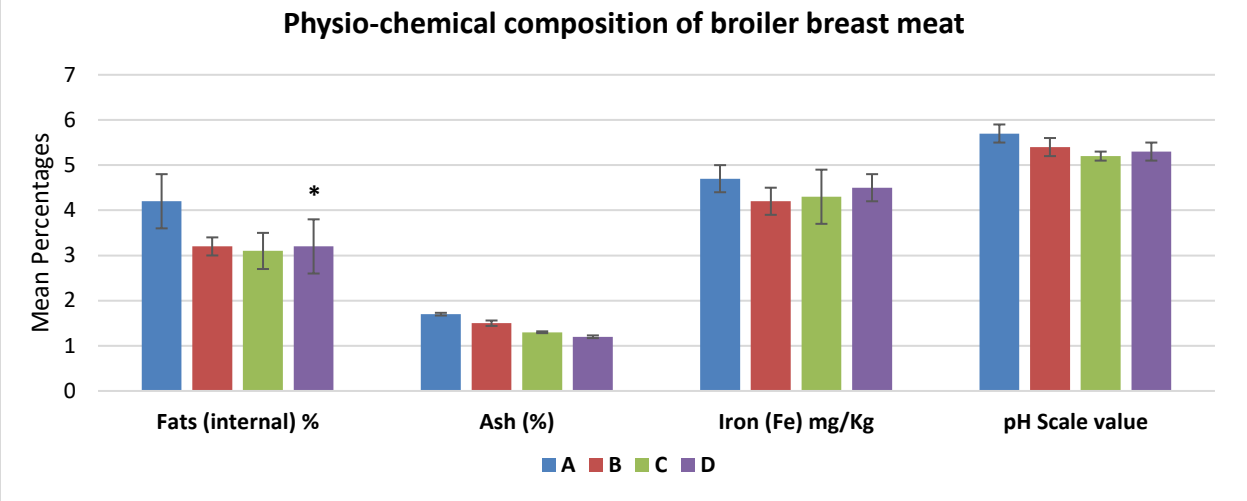


**Fig. 2:** The effect on the physio-chemical composition of broiler breast meat with onion supplementation of 0, 4, 5, and 5.5 gm/kg feed, representing groups A, B, C, and D, respectively. The only significant (P<0.05) changes were observed in internal fat in all tested groups compared to control. In comparison, a non-significant effect was noticed in mean ash percentage, iron mg/kg of meat, and pH in raw breast meat of broiler after treatment. Data are represented as mean ± SD of three experiments (n=3).

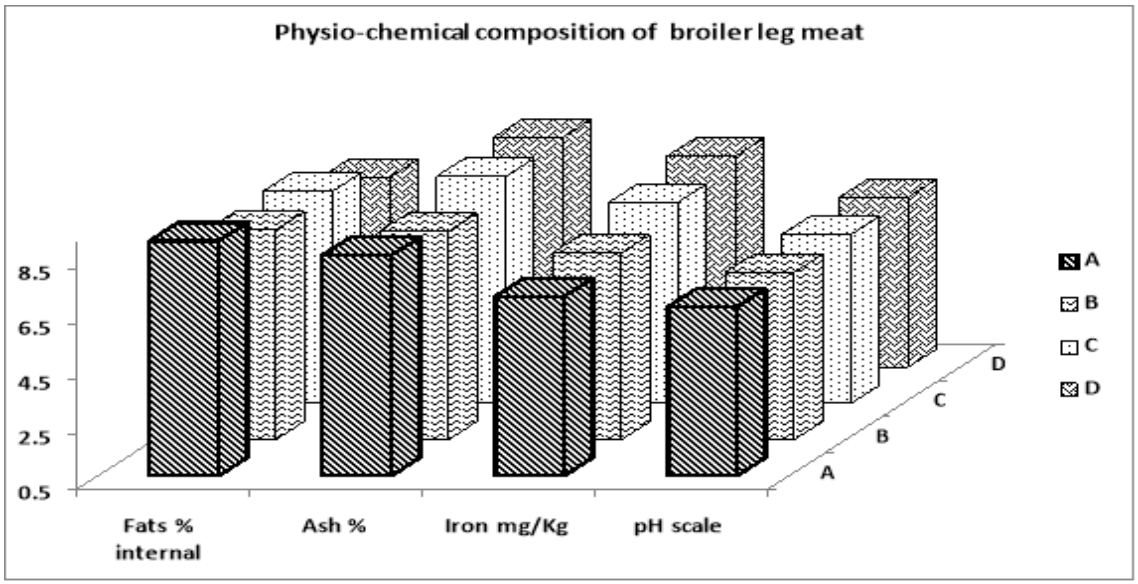


**Fig. 3:** The effect on the physio-chemical composition of boiler leg meat with onion supplementation of 0, 4, 5, and 5.5 g/kg feed, representing groups A, B, C, and D, respectively. The only significant changes were observed in internal fat in all tested groups compared to control. In contrast, a non-significant effect was noticed in mean ash percentage, iron mg/kg of meat, and pH in raw breast meat of broiler after treatment. Data is shown as an average of mean percentages, where n=3.

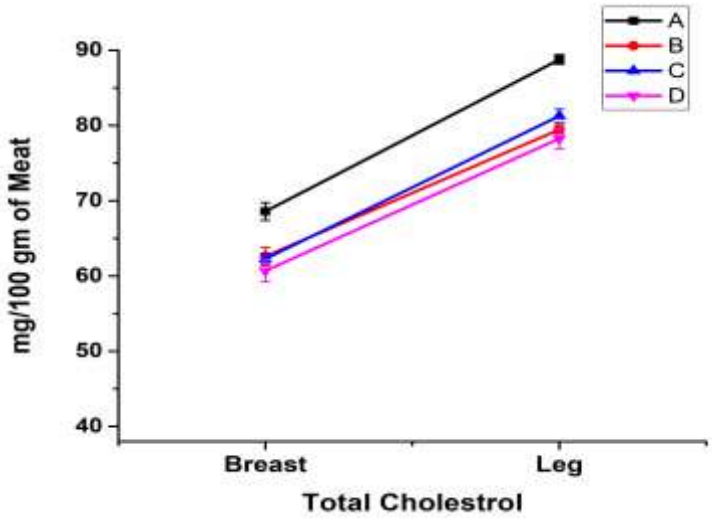


**Fig. 4:** The mean comparison of total cholesterol between breast and leg of boilers, supplemented with different onion concentrations (0, 4.5, 5, and 5.5 gram/kg), grouped as A, B, C, and D. The average total cholesterol in breast and leg meat samples decreased with onion in comparison to control group. Data is represented as Mean ± SD for three independent experiments (n=3).

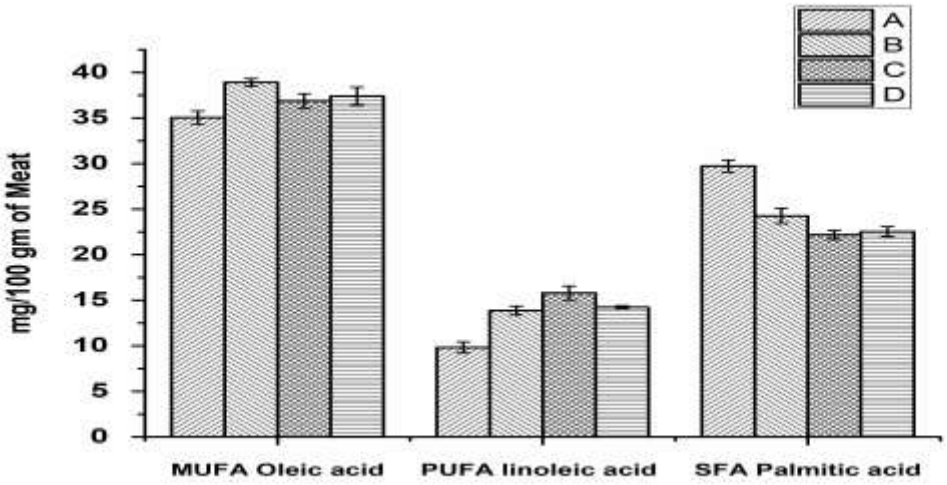


**Fig. 5:** The effect of onion supplementation on the mean mg/gram of meat samples fatty acid. The broilers were fed with different onion concentrations (0, 4.5, 5, and 5.5 g/kg), grouped as A, B, C, and D. The treated groups showed significant ($P<0.05$) changes in PUFA linoleic acid and MUFA oleic acid with onion supplementation.

ration enhanced whole tract digestibility of the nutrients in broiler birds [25].

Moreover, the ratio of total saturated fatty acids (TSF) to total unsaturated fatty acids (TUF) was calculated to precisely indicate the changes in fatty acids due to the additives. It is evident from **Fig. 5** that significant changes were found in fatty acids, indicated as a 24% change in palmitic acid, 35% in unsaturated fatty acids (oleic acid), and 9% in linoleic acid. The significant alterations of palmitic and oleic acid (saturated and unsaturated fatty acids) were concurrent with the previously evaluated study on broiler meat [30]. The best result was found by the feed changes that help in meat fatty acid composition [31]. Around sixty percent of saturated fatty acid in the United States is obtained from canola oil. Besides being a rich source of unsaturated fatty acid and oleic acid, this efficiently reduces plasma LDL without affecting HDL levels

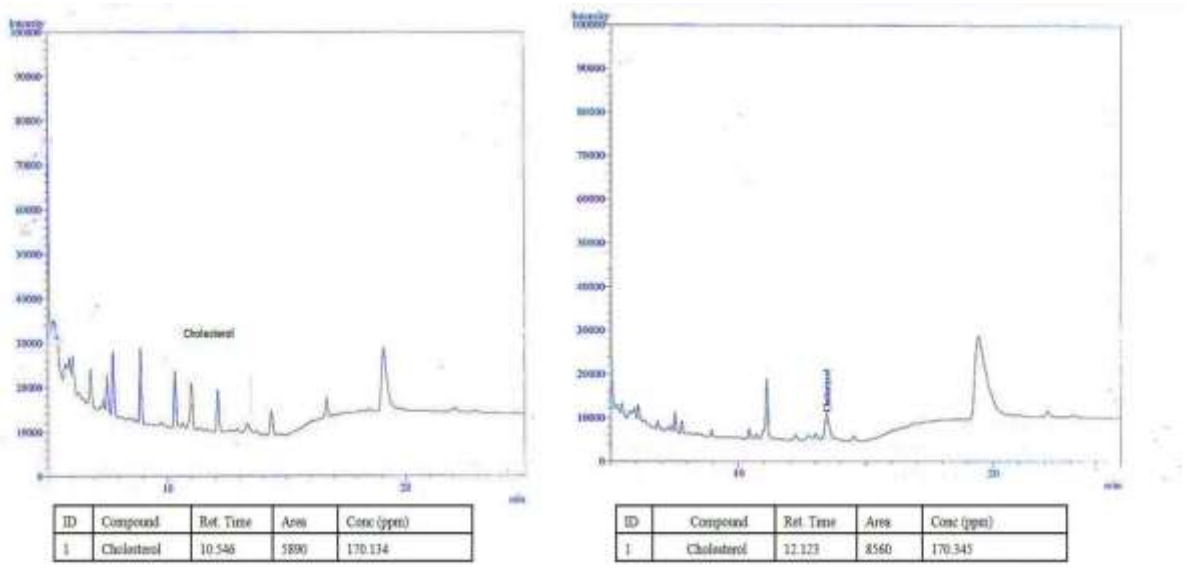


**Fig. 6:** GC-FID graph of group BR1and AR1 shows total cholesterol in breast meat sample supplemented with 0 and 4.5 gram/ kg of onion feed to AR1 and BR1 groups, respectively

[32]. Different results showed that onion supplementation in the diet altered the saturated fatty acid to unsaturated fats with impactful health benefits [33]. Another study demonstrated that the dietary supplementation of Vit E changes the fatty acid composition of breast muscles, lowers the level of total saturated fatty acid and enhances the unsaturated fatty acid. Onion powder improved meat's fatty acid and quality by altering the gene responsible for lipid metabolism.

## Conclusion

This study emphasizes the health benefit of onion supplementation on meat quality. Our results demonstrated the improved meat characteristics by including onion feed at the doses of 4.5 and 5.5 grams/ kg. We also concluded that onion had a positive impact on the chemical composition of muscles. The best results were found in groups C and D that had received onion at 5 and 5.5gram/ kg of feed. This study concluded that onion supplementation in a range of 5-5.5 grams per Kg of feed improved the meat quality and had a significant effect on the fatty acid and cholesterol level of broiler meat.

## List of Abbreviations

| | |
|---|---|
| AOAC | Association of Analytical Communities |
| ANOVA | Analysis of variance |
| CP | Crude protein |
| CRD | Complete random design |
| DM | Dry matter |
| EE | Ether extract |
| GC | Gas Chromatography |
| HDL | High-density lipoprotein |
| IB | Infectious bronchitis |
| IBD | Infectious bursal disease |
| LA | Linoleic acid |
| LDL | Low-density lipoprotein |
| ND | Newcastle disease |
| SD | Standard Deviation |
| SFA | Saturated fatty acid |
| TSF | Total saturated fatty acids |
| TUF | Total unsaturated fatty acids |
| VRI | Veterinary Research Institute |

### Conflict of interest

The authors declare no conflict of interest.

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