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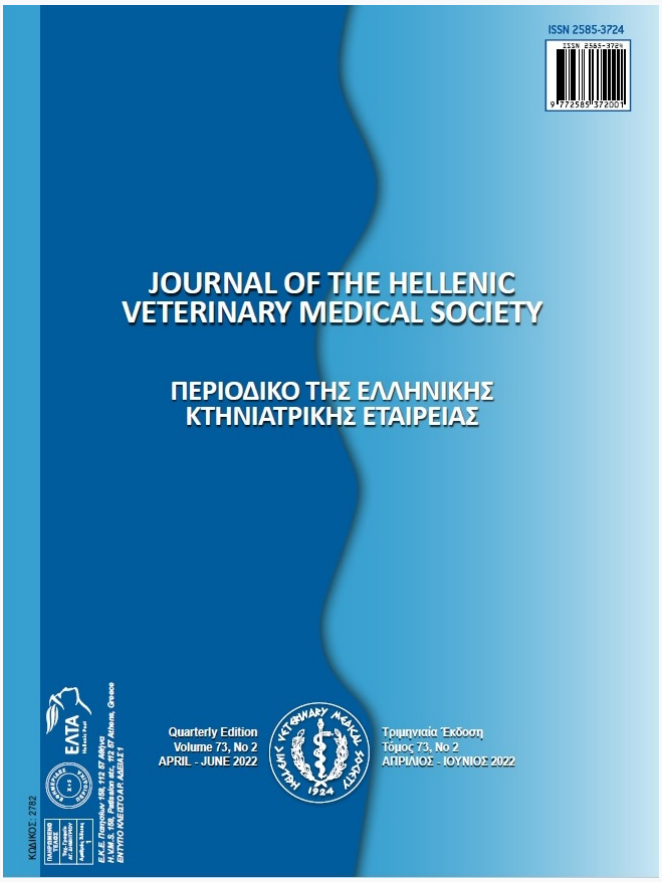


# Effects of garlic and onion powder on egg production, antioxidant status and some blood parameters in chukar partridges

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Research article
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# Effects of garlic and onion powders on egg production, antioxidant status and some blood parameters in chukar partridges

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**ABSTRACT:** The study aimed to evaluate the effect of onion (*Allium cepa*) and garlic (*Allium sativum*) powders on egg production, antioxidant capacity and blood biochemistry in chukar partridges (*Alectoris chukar*). The study was conducted for 12 weeks during the laying period and a total of 240 partridges were divided into 4 groups (control, 1% onion, 1% garlic, and mixture of 1% onion and1% garlic powders).The highest total antioxidant capacity, feed consumption and egg production were determined in the garlic group ($P < 0.05$ and $P < 0.01$ respectively) and the lowest egg production and feed intake were observed in the onion group. Egg production in the mixture of garlic and onion group was also higher than the control and only onion group ($P < 0.01$). While there was no statistical difference in blood HDL (High Density Lipoprotein), LDL ( Low Density Lipoprotein), glucose, alkaline phosphatase, calcium, and phosphorus levels ($P >0.05$), blood urea, ALT (Alanine Aminotransferase) , AST (Aspartate Aminotransferase) levels were higher ($P < 0.05$) in the garlic group with the highest egg production and feed intake ($P < 0.01$) compared to the control and onion groups. Unlike many studies, the highest cholesterol levels were determined in the garlic supplemented group ($P < 0.05$) and the expected positive effects were not seen in onion powder.

***Keywords:*** Partridge, onion, garlic, egg production, antioxidant status, blood biochemistry.

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## INTRODUCTION

Partridges are commonly maintained for hobby purposes and chukar partridges are the most adapted species for commercial production and breeding is mostly done to provide birds for hunting (Kirikci et al., 2002, Alkan et al., 2008). It has been reported that raising partridges for meat production has become more widespread (Özek et al., 2003). However, the number of birds in the wild has diminished in recent years due to excessive hunting, habitat destruction and indiscriminate use of pesticides and fertilizer (Kirikci et al., 1999, Karabag et al., 2010).

Chukar partridges have a wide natural habitat in Turkey. It has been known that chukar partridge's laying period is between April and August in Turkey in natural conditions. Approximately 20-60 eggs can be taken in the 10-16 weeks of laying period, depending on the age, care, feeding, and rearing system in chukar partridges (Woodard et al., 1978, Alkan et al., 2008). Studies on age, lighting, body weight, and feeding, which are among the environmental factors that affect egg production, are limited (Kırıkçı et al., 2007).

Bulbous plants have high antioxidant activity due to the flavonoids in their structure. Both garlic (*Allium sativum*) and onion (*Allium cepa*) are in the family of *Alliaceae* and are used in nutrition and raw material in the drug industry. It has been reported that both garlic and onion contain phenolic compounds like gallic acid, quercetin, myricetin in considerable amounts (Yünlü and Kır., 2016). Polyphenolics have wide biological effects such as antibacterial, anti-inflammatory, antiallergic, hepatoprotective, antithrombotic, antiviral, anticarcinogenic and vasodilatory actions. In addition, it has been expressed that free radical scavenging and antioxidant activity cause these biological functions (Middleton et al., 2000). The sources of the pharmacological actions of phenolic antioxidants are their free radical scavenging, metal chelating properties, their effects on cell signalling pathways and on gene expression. The antioxidant capacities of phenolic compounds were evaluated by using the Trolox equivalent antioxidant capacity (TEAC), the ferric reducing antioxidant power (FRAP), the hypochlorite scavenging capacity, the deoxyribose method and the copper-phenanthroline-dependent DNA oxidation analyzes (Soobrattee et al., 2005).

Dietary strategies are important in improving egg and meat production in the poultry industry. Allicin and its species that are active ingredient of garlic have properties such as antibacterial, anticoccidial, antifungal, antiviral, immune-enhancing and antioxidant capacity-enhancing, and its use is becoming widespread in poultry feeding (Wang et al., 2017). Studies in animals and humans have also revealed that garlic has hypotensive and hypoglycemic properties (Yang et al., 2018, Borgohain et al., 2019, Zhu et al., 2018). The hypolipidemic effects of garlic are mediated by different mechanisms. Garlic reduces the lipogenic and cholesterogenic activities of enzymes such as malic enzyme, fatty acid synthase, glucose-6 phosphate dehydrogenase, and 3-hydroxy-3-methyl-glutarylCoA (HMGCoA) reductase in liver cells (Yan and Liu, 2001). In the literature, there are studies about proving the positive effect of onion and garlic powders on egg production, in laying hens (Khan et al., 2012, Damaziak et al., 2017, Mahmoud et al., 2010) but no studies were found about garlic or onion supplementation in chukar partridges. The present study aimed to determine the effects of onion and garlic powders on egg production, feed intake and total antioxidant status in chukar partridge.

## MATERIALS AND METHODS

### Animals, housing and experimental design

The study was carried out between April and July at Bahri Dagdas International Agricultural Research Institute (37° 52′ 5.7612" and 32° 33′ 12.8088"), the climate condition was dominantly seen as steppe. This study was approved by the Ethics Committee of the Experimental Medicine Research and Application Centre of Selcuk University, 2020 / 60 report.

Chukar partridges were obtained from Bahri Dagdas International Agricultural Research Institute's poultry farm. 240 partridges at 60 weeks of age were used in the study and were kept in 4 outdoor cages which 120 cm × 115 cm × 600 cm dimensions. 45 female and 15 male partridges were placed in each cage. The period of 16 hours light and 8 hours dark was applied throughout the experiment total of 12 weeks.

### Diet

The study was conducted in four groups as control, 1% onion, 1% garlic and mixture of 1% onion and 1% garlic powders (Omer et al., 2019).Onion and garlic powders which produced by oven drying were obtained from a local spice shop (Kurucum Gıda) in Isparta / TURKEY and mixed to the commercial laying hen feed which the composition is given in Table 1.

The mixing process was conducted with a 5 kg ca-

pacity bucket. Firstly 100 g onion and / or 100 g garlic powder added to 1 kg feed and mixed and shook for 5 minutes manually. After this step, 9 kg of feed was added to this mixture and mixed for 15 minutes manually with a hand shovel on the ground.

Feed was given ad-libitum with 15 kg capacity ground feeders and feed consumption was recorded with weekly intervals. Water was given ad-libitum with a nipple system. The study was carried out for 12 weeks and feed adaptation was conducted first 2 weeks. The data of the adaptation period wasn't used.

**Sample collection and measurement of blood parameters.**

At the end of the study, 8 female partridges were randomly selected from each group and jugular vena was cut with a sterile lancet, and 5-6 ml blood was taken to the clot activator tubes. Samples were centrifuged at 3000 g for 10 minutes and stored at -20 $^{0}$ Cuntil the analysis. Serum calcium, phosphorus, glucose, total cholesterol, HDL, LDL, alkaline phosphatase, urea, ALT, and AST levels were determined with an autoanalyzer (Abbott Architect C8000) by colorimetric method.

For determining total antioxidant status, ABTS ((2,2′-Azino-bis (3-ethylbenzothiazoline-6-sulfonic acid)) radical was used and analysis was performed with Mindray BS400 autoanalyzer by colorimetric method.

**Statistical analysis.**

Statistical analysis was performed with SPSS 23.0 software. Data distribution of blood parameters were abnormal and nonhomogeneous to the Kolmogorov Smirnov and Shapiro - Wilk test and therefore Kurskal - Wallis test was performed for determining the statistical difference between groups. The daily egg production rate was calculated with [ (Number of eggs / number of live female partridge) x 100] formula and differences were analyzed by one-way ANOVA. Duncan's multiple tests was performed to determining statistical significances in egg production rate between groups. Feed consumption data was recorded with weekly intervals and calculated with [weekly feed consumption (g) / weekly live partridge number] and analyzed by one-way ANOVA. Duncan's multiple test was performed to determine statistical significances between groups.

## RESULTS

The highest egg production rate was observed in the garlic group ($P < 0.01$). At the same time, feed consumption increased with garlic powder and the lowest egg production and feed consumption were obtained in the onion group ($P < 0.01$). Onion and garlic mixture provided a positive effect on egg production with less feed consumption compared to the control group.

The total antioxidant status of the garlic group was

**Table 1.** Composition of diet

| Ingredients | | Nutrients | |
|---|---|---|---|
| Corn (%) | 42.50 | ME (kcal/kg) | 2700 |
| Soybean meal (%) | 27.67 | Crude protein (%) | 17.00 |
| Boncalite (%) | 17.58 | Crude fiber (%) | 4.0 |
| Marble powder (%) | 9.41 | Crude fat (%) | 4.20 |
| Soybean fat (%) | 0.91 | Crude ash (%) | 14.00 |
| Sodium (%) | 0.16 | | |
| Lysine (%) | 0.75 | | |
| Methionine (%) | 0.36 | | |
| Calcium (%) | 4.00 | | |
| Dicalcium phosphate 18 (%) | 0.80 | | |
| Phosphorus (%) | 0.60 | | |

**Table 2.** Egg production and feed consumption, (per partridge)

| Groups | Daily egg production rate (%) | Weekly feed consumption (g) |
|---|---|---|
| Control | $21.93 \pm 1.15^{b}$ | $366.89 \pm 7.98^{a}$ |
| Onion | $21.20 \pm 0.98^{b}$ | $293.13 \pm 8.10^{b}$ |
| Garlic | $32.95 \pm 1.58^{a}$ | $376.40 \pm 5.43^{ac}$ |
| Onion and Garlic | $26.24 \pm 0.67^{a}$ | $325.02 \pm 4.93^{b}$ |

a, b; Different letters mean statistical significance in the same row ($p<0.01$).

**Table 3.** Effects of garlic and/or onion on blood parameters (mean ± standard error of mean)

| Parameters (n=8) | Control | Garlic | Onion | Onion and Garlic |
|---|---|---|---|---|
| TAS (mmol/L) | 2.65 ± 0.25$^{ab}$ | 2.85 ± 0.17$^{a}$ | 2.39 ± 0.13$^{b}$ | 2.66 ± 0.17$^{ab}$ |
| LDL (mg/dl) | 81.87 ± 9.54 | 100.22 ± 19.91 | 65.25 ± 6.63 | 76.55 ± 13.95 |
| HDL (mg/dl) | 49.4 ± 9.39 | 48.7 ± 7.94 | 52.96 ± 10.97 | 64.67 ± 12.26 |
| Cholesterol (mg/dl) | 188 ± 15.10$^{a}$ | 265.63 ± 42.65$^{b}$ | 164.03 ± 14.57$^{a}$ | 203.12 ± 68$^{ab}$ |
| Glucose (mg/dl) | 353.87±14.64 | 333.125±7.98 | 344.25±8.98 | 325.75±10.62 |
| ALT (U/L) | 10.68±1.18$^{a}$ | 13.32±3.39$^{b}$ | 10.78±0.84$^{a}$ | 12.61±0.97$^{ab}$ |
| AST (U/L) | 292.37 ± 34.95$^{a}$ | 403.37 ± 48.19$^{b}$ | 266.75± 25.86$^{a}$ | 308 ± 31.51$^{ab}$ |
| Urea (mg/dl) | 2.24±0.56$^{a}$ | 2.96±0.9$^{b}$ | 2.52±0.48$^{ab}$ | 3.02±0.33$^{b}$ |
| Alk P (U/L) | 815.12±151.67 | 731.62±72.22 | 672.37±138.01 | 686.19±125.55 |
| Ca (mg/dl) | 18.37±5.01 | 18.66±4.5 | 16.72±5.67 | 16.2±5.63 |
| P (mg/dl) | 5.96±1.8 | 6.38±1.01 | 5.02±1.49 | 5.65±2.05 |

a, b; Different letters mean statistical significance in the same row ($p<0.05$).
(TAS: Total antioxidant status, LDL: Low-density lipoprotein, HDL: High-density lipoprotein, ALT: Alanine aminotransferase, AST: Aspartate aminotransferase, Alk P: Alkaline phosphatase, Ca: Calcium, P: Phosphorus)

higher than the onion group and ALT, AST, urea levels in the garlic group were higher than the control and onion group ($p < 0.05$). Although the numerical differences in HDL, LDL, and alkaline phosphatase levels, there was no statistical significance between groups and also glucose, calcium and phosphorus levels were similar ($P > 0.05$).

## DISCUSSION

The present study aimed to determine the effect of onion and / or garlic powder supplementation on egg production in chukar partridges**.** It was observed that egg production increased significantly in partridges fed with 1% garlic powder and the highest egg production rate was observed in the garlic group ($P < 0.01$). Also, egg number in the onion and garlic group was significantly higher than the control and only onion group ($P < 0.01$), (Table 2). Damaziak et al has been reported that onion and garlic powder extracts increased egg production in laying hens (Damaziak et al., 2014). Omer et al reported that garlic and onion powders increased egg production and decreased feed consumption in layers (Omer et al., 2019) and Ooi et al proved that 1% onion powder increased egg production (Ooi et al., 2018). Kolawole and Folake has been reported that 1% garlic powder has no effect on feed consumption and egg production in laying hens,and 2% garlic powder decreased both of them (Kolawole and Folake, 2019). In another study, Mahmoud et al has been reported that garlic juice has no effect on egg production in layers (Mahmoud et al., 2010). In the present study, it was seen that the highest egg production in the garlic group with highest feed consumption ($P < 0.01$) and egg production in chukar partridges was positively affected by using the garlic powder and, mixture of onion and garlic powders ($P < 0.01$). It can be said that using mixture of garlic and onion powders increased egg production with lower feed consumption than the control group. Contrary to the expected effect in the onion powder group, the feed consumption and egg production were lower than the control group and so that it has been thought that chukar partridges did not like the onion powder supplemented feed. According to the results of this study, it can be said that the positive effect on egg production that observed in mixture ofonion and garlic powders is due to garlic powder.

Spices contain well-known antioxidants such as ascorbic acid (vitamin C), tocopherols (vitamin E), phenols, thiols, sulfur components and carotenoids. In addition to these ingredients, it has been reported that allicin, the active ingredient of garlic, scavenges reactive oxygen species, and protects lipids from peroxidation (Wilson and Adams, 2007). It has been reported that egg production increased with vitamin E supplementation in chukar partridges (Şengül et al., 2008). Choi et al reported that malondialdehyde levels in chicken meat decreased in parallel with increasing garlic doses in broilers (Choi et al., 2010). Pourali et al determined that 5% garlic powder decreased nitric oxide and malondialdehyde levels, but did not affect superoxide dismutase and glutathione peroxidase levels in broilers infected with *Eimeria* (Pourali et al., 2014). Ismail et al proved that garlic powder significantly increased the superoxide dismutase and total antioxidant capacity levels in the broilers while decreasing the malondialdehyde levels (Ismail et al., 2020).

In the literature, there is no study on the effect of onion and /or garlic on the antioxidant capacity of chukar partridges. Yardibi and Türkay reported that vitamin E supplementation provided a significant decrease in MDA levels and a significant increase in egg production in laying hens (Yardibi and Türkay, 2008). In the present study it has been determined that total antioxidant status inthe garlic group was higher than the control and mixture of onion and garlic group but no significance ($P > 0.05$) and significantly higher thanthe onion group ($P < 0.05$, Table 3). The lowest total antioxidant status and the lowest egg production were observed in the onion group, while the highest egg production and total antioxidant status were observed in the garlic group. So it can be said that there is a relationship between antioxidant status and egg production in chukar partridges.

It has been reported that garlic reduces blood cholesterol levels and this effect is caused by a component called S-methylcysteine sulfoxide (Thomson and Ali, 2003). Studies in chickens have also demonstrated the hypolipidemic effects of garlic powder or extracts (Khan et al., 2012, Choi et al 2010., Kim et al., 2009, Ao et al., 2011). It has been reported that cholesterol levels in rock partridges were 182.54 - 212.91 mg/dL (Özbey and Esen, 2007), in chukar partridges, were 176.46-191.83 mg/dl (Özek and Bahtiyarca 2004), 194.1 mg/dL (Khaksar et al., 2013), and 174.50-189.80 mg/dl (Sevim et al., 2020) on out of the egg production season. There is no study in the literature investigating garlic and / or onion powder's effect on cholesterol levels during the egg production season in chukar partridges. In the present study, cholesterol levels were similar to the other studies (Özbey and Esen, 2007, Özek and Bahtiyarca 2004, Khaksar et al., 2013, Sevim et al., 2020).Unlike lots of literature, in the present study, cholesterol levels in the garlic group ($265.63 \pm 42.65$ mg/dl) were higher than the control and onion groups ($P < 0.05$), and HDL and LDL levels were not affected by garlic or onion supplementation. The highest egg production rate, feed consumption and cholesterol levels were determined in the garlic group but these parameters were lowest in the onion group. With this information, it has been thought that cholesterol levels were affected by egg production and feed consumption in chukar partridges. The highest levels of ALT, AST, urea and cholesterol were observed in the garlic group. It has been thought that high egg production and high feed consumption have negative effects on liver functions. (Table 3).

## CONCLUSIONS

Egg production and total antioxidant status increased by using the 1% garlic powder and, mixture of 1% onion and 1% garlic powders. Only onion powder had a negative effect on egg production and feed consumption. According to the results of this study, it can be said that there is a relationship between egg production and antioxidant capacity. Chukar partridges are a type of game bird that give fewer egg and difficult to breed. With this study's results, it can be said that garlic and mixture of onion and garlic powders may be beneficial on egg production in game birds like chukar partridges.

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## CONFLICT OF INTEREST

None declared**.**

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