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ARAŞTIRMA MAKALESI

Evaluating the Impact of Dried Onion and Garlic on Egg Hatching Performance and Embryonic Mortality of Chukar Partridges

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Anahtar kelimeler Kınalı keklik, soğan, sarımsak, kuluçka randımanı, embriyonik ölüm

Abstract

The impacts of different levels of dried onion and garlic in the ration of chukar partridges were examined on hatching performance and embryonic mortality in eggs stored for different storage periods. The study was carried out on 60-week-old healthy partridges from the breeding flock of the experimental station. The partridges were divided into four dietary groups: group C (control); group %1O (1% onion); group %1G (1% garlic); group %1GO (1% onion + 1% garlic). The highest fertility rate was observed in group %1GO with 95.20 % in eggs stored for 15-to-21 days, while group C showed the lowest fertility rate with 84.60% in eggs stored for 0-to-7 days ($P < 0.05$). The highest hatchability of total eggs was demonstrated in group %1GO with rate of 84.30% for eggs stored for 8-to-14 days. With respect to hatchability of fertile eggs, the highest value was exhibited by group %1GO with 89.30% of eggs stored for 8-to-14 days. The highest value (early embryonic deaths) was seen in group %1O with 14.2% stored for 22-to-28 days ($P < 0.05$). In mid-term embryonic deaths, differences between groups were found to be insignificant. Late embryonic deaths were higher in group C in eggs stored for 0-to-7, 8-to-14, 15-to-21 days, and higher in group %1G in eggs stored for 22-28 days.

Kınalı Keklik Yumurtalarında Kurutulmuş Soğan ve Sarımsağın Embriyonik Ölüm ve Kuluçka Performansına Etkisinin İncelenmesi

Özet

Bu çalışmada; kınalı keklik rasyonlarına farklı oranlarda kurutulmuş soğan ve sarımsak tozu kullanımının farklı periyotlarda depolanan yumurtalarda kuluçka performansı ve embriyonik ölüm üzerine etkileri incelenmiştir. Çalışma keklik üretim tesisinde bulunan 60 haftalık yaşta 240 adet (180 dişi, 60 erkek) sağlıklı anaç keklikler üzerinde yürütülmüştür. Keklikler kontrol grubu (grup C); grup %1O (%1 soğan); grup %1G (%1 sarımsak); grup %1GO (%1 soğan + %1 sarımsak) olmak üzere dört muamele grubuna ayrıldı. En yüksek fertilite oranı 15-21 gün arasında depolanan yumurtalarda %95.20 ile %1GO'da gözlenirken, en düşük fertilite oranı kontrol grubu'nda %84.60 ile 0-7 gün arasında depolanan yumurtalarda görüldü ($P < 0.05$). En yüksek kuluçka randımanı, 8-14 gün depolanan yumurtalarda %84.30 ile %1GO'da görüldü. Fertil yumurtaların kuluçka randımanı açısından en yüksek değer, 8-14 gün arasında depolanan yumurtalarda %89.30 ile grup %1GO'da görülmüştür. Erken embriyonik ölüm bakımından en yüksek değer 22 - 28 gün arasında depolanan yumurtalarda %14.2 ile grup %1O'da görüldü ($P < 0.05$). Orta dönem embriyonik ölümler bakımından gruplar arasındaki farklar önemsiz bulundu. Geç dönem embriyonik ölümler ise C grubunda 0-7, 8-14, 15-21 gün depolanan yumurtalarda daha yüksek iken , grup %1G'de 22-28 gün depolanan yumurtalarda diğer gruplara göre daha yüksekti ($P < 0.05$).

Introduction

One of the most widely grown game birds in the world is the Chukar partridge (Alectoris chukar). It lays eggs between April and June under normal conditions and can be produce approximately 20-60 eggs during laying period (10-16 week). Egg productivity is affected by diseases along with age, hen's weight,

maintenance, feeding and rearing system (Kırıkçı et al., 2007; Roberts et al., 2011; Kırıkçı et al., 2018). Microbial infections are one of key factors that reduce hatchability and chick quality in hatching eggs (Baylan et al., 2018). Although routine antibiotics are used in the prevention of such pathological events, these drugs have been banned due to systematic increase in bacterial resistance and residues of antibiotics used as raw materials in some countries (Damaziak et al., 2017; Sevim et al., 2020). These prohibitions have led to the use of different alternatives as feed additives in poultry nutrition. One of these alternatives is plant extracts (Şeker, 2003), which are obtained from plants such as onion and garlic (Damaziak et al., 2017; Abd El-Motaal et al., 2008).

Some studies have shown that some herbs and their extracts have biological activities such as antibacterial, antiparasitic, antiviral and antioxidant (Kamel et al., 2001; Youn and Noh, 2001; Botsoglou et al., 2002; Papageorgiou et al., 2003; Lee et al., 2002; Behnamifar et al., 2015). The bulbous plants have high antioxidant activity due to the flavonoids in their structure. Garlic (Allium sativum) and onion (Allium cepa) used both as food and pharmaceutical raw materials are the most important plant groups of the Alliaceae family. This group of plants contains many phytochemicals with different bioactive properties such as antioxidative activity. More than 200 components of garlic and onion, such as vitamins, sulfur-containing compounds, amino acids, proteins, lipids and trace elements (selenium, flavonoids and various antioxidants) have been identified (Benkeblia, 2005; Yunlu and Kir, 2016). While garlic has hypotensive, hypoglycemic, hypotrombotic, and hypoatrogenic properties (Kim et al., 2018), onion, as a powerful antioxidant, is considered a rich source of guercetin which protects against diseases caused by oxidative stress (McDermott, 2000; Arabbi et al., 2004). Effects of onion and garlic extracts on hatching studies in poultry were reported by many researchers (Damaziak et al., 2017; Khan et al., 2007).

In hatching eggs, storage time is an important factor affecting hatching characteristics. Despite negative relationships between storage time and hatchability were reported in partridges (Woodard and Morzenti, 1975) and pheasants (Demirel and Kırıkçı, 2009), there is no literature data examining the effects of onion and garlic on storage time. In this study, the effects of onion and garlic powder added to the ration at different levels were investigated on hatching performance and embryonic mortality in eggs stored for different periods in chukar partridges.

Material and Method

The experimental procedures used throughout this study were approved by the Selcuk University Experimental Animal Production and Research Center Ethics Committee (SÜVDAMEK) (Resolution No. 2020/60 of 9 July 2020)

The experimental material consisted of chukar partridges (Alectoris chukar) in their first reproductive season, kept in Konya Bahri Dağdaş International Agricultural Research Institute (37°51'38.2"N, 32°35'02.0"E) in three separate cages. A total of 180 female and 60 male chukar partridges (60-week-old) were allocated into four dietary groups. Each group consisted of 45 female and 15 male partridges (Kırıkçı et al., 2018). This study was conducted in May, June and July in 2020.

Breeder partridges were fed basal nutritious diet (Table 1) as group C supplemented with 1% onion (group %1O), 1% garlic (group %1G) and 1% onion + 1% garlic (group %1GO). The addition of onion and garlic powder to basal nutritious diet started two weeks before the study. Dried onion and garlic were purchased from a commercial enterprise (Kurucum Gıda).

Table 1. Basal diet composition [expresend as percentage]

	Percentage (%)
Corn	41.36
Soybean meal	26.07
Bonkalite	16.58
Marble powder	9.01
Soybean fat	0.91
Sodium	0.16
Lysine	0.75
Methionine	0.36
Calcium	3.40
Dicalcium phosphate 18	0.80
Phosphorus	0.60
Total	100
Crude Protein	17.13
Crude Fiber	4.0
Crude Fat	4.2
Crude Ash	13.42

The birds were kept outdoors, in cages of the following dimensions: 120 cm length × 115 cm width × 600 cm height. Each cage was equipped with three nipple drinkers with a feeder. Feed and water were given as ad libitum. Throughout the experiment, the partridges were provided with artificial illumination in addition to daylight, equivalent to 16 hours of light a day and 8 hours of darkness.

The eggs were collected separately daily at 15:00 according to the feeding groups and stored according to storage time (0-to-7 day, 8-to-14 day, 15-to-21 day, 22-to-28 day) in the storage room at 70% humidity and 17 ^{0}C temperature (Ozlu et al., 2021). Dirty and broken eggs were excluded from this study. The hatching Eggs were placed in a refrigerator type incubator (Çimuka T1600 C - Turkey) and incubated at 37.5 ^{0}C and 59% relative humidity for during 21 days. Machine was set at 37 ^{0}C and 72% relative humidity in the 21st day of incubation. Non-hatching eggs were examined in three (Kırıkçı et al., 2018) groups (early, middle and late embryonic deaths) as macroscopically weekly. The formulas of the reported indicators in the study are given in the box [Box 1] below:

Box 1. Employed indicators in the study (Baylan et al., 2018)

Fertility rate (%): (number of fertilized eggs/number of eggs set) x100
Hatchability of total eggs (%): number of hatched chicks /total number of eggs set) x100
Hatchability of fertile eggs (%): (number of hatched chicks /number of fertilized eggs set) x100
Early embryo mortality (%): (number of dead embryos on days 0-6 of incubation/number of fertilized eggs) x100
Mid-term embryo mortality (%): (number of dead embryos on days 7-18 of incubation/number of fertilized eggs) x100
Late embryo mortality (%): (number of dead embryos on 19-21 days of incubation/number of fertilized eggs) x100

The data were analyzed by Pearson's chi-square procedures using SPSS (Version 23.0).

Results

The fertility rates, hatchability of total eggs and hatchability of fertile eggs values of the groups in different egg storage periods are given in Table 2.

The highest fertility rate was demonstrated by group %1GO with 95.20% in eggs stored for 15-to-21 days, while the lowest fertility rate was reported in Group C with 84.60% in eggs stored for 0-to-7 days ($P<0.05$). The highest hatchability of total eggs was obtained in group %1GO with the rate of 84.30% for eggs stored for 8-to-14 days. In terms hatchability of fertile eggs, the highest value was 89.30% from eggs stored in group %1GO for eggs stored for 8-to-14 days.

Table 2. Fertility rates, hatchability of total eggs and hatchability of fertile eggs values of the dietary groups in different storage periods

		Study groups				
	Storage period (d)	**C n = 458**	**Group %1O n = 447**	**Group %1G n = 660**	**Group %1GO n = 609**	**Total n =2174**
Fertility rates (%)	0-7 day	84.60^{b}	89.90^{ab}	$89.20^{ab}{}_{XY}$	94.70^{a}	90.30_{XY}
	8-14 day	88.90	92.40	94.10_{X}	94.30	92.70_{Y}
	15-21 day	92.50^{ab}	88.80^{b}	$91.60^{ab}{}_{X}$	95.20^{a}	92.70_{Y}
	22-28d ay	86.50^{ab}	90.40^{ab}	$82.90^{b}{}_{Y}$	91.40^{a}	87.50_{X}
	Total	88.40^{b}	90.40^{b}	89.80^{b}	94.10^{a}	
Hatchability of total eggs (%)	0-7 day	60.00^{c}	$68.40^{bc}{}_{X}$	$75.80^{ab}{}_{X}$	$80.30^{a}{}_{X}$	73.40_{XY}
	8-14 day	62.60^{c}	$68.60^{bc}{}_{X}$	$76.20^{ab}{}_{X}$	$84.30^{a}{}_{X}$	74.50_{Y}
	15-21 day	64.40^{b}	$67.20^{b}{}_{X}$	$63.30^{b}{}_{Y}$	$78.30^{a}{}_{X}$	68.50_{X}
	22-28 day	54.10	50.40_{Y}	50.70_{Z}	57.90_{Y}	53.40_{Z}
	Total	60.00^{c}	63.10^{ab}	67.00^{b}	75.20^{a}	
Hatchability of fertile eggs (%)	0-7 day	70.90^{b}	$76.10^{ab}{}_{X}$	$85.00^{a}{}_{X}$	$84.80^{a}{}_{XY}$	81.30_{X}
	8-14 day	70.50^{c}	$74.30^{c}{}_{X}$	$81.00^{b}{}_{X}$	$89.30^{a}{}_{X}$	80.40_{X}
	15-21 day	69.60^{b}	$75.70^{ab}{}_{X}$	$69.10^{b}{}_{Y}$	$82.30^{a}{}_{Y}$	73.90_{Y}
	22-28 day	62.50	55.80_{Y}	61.10_{Y}	63.30_{Z}	63.10_{Z}
	Total	67.90^{c}	69.80^{bc}	74.50^{b}	80.10^{a}	

a, b, c; Means with different superscripts within a row differ at $P < 0.05$.
x, y, z; Means with different subscripts within a column differ at $P < 0.05$.

In different storage periods, embryonic deaths obtained from the groups are presented in Table 3.

According to the findings, in terms of early embryonic deaths the difference between eggs stored for 0-to-7, 8-to-14, 15-to-21 days was found to be insignificant. The highest value (early embryonic deaths) was 14.2% in group %1O stored for 22-to-28 days ($P < 0.05$). In mid-term embryonic deaths, differences between groups were found to be insignificant. Late embryonic deaths were higher in C group %1On eggs stored for 0-to-7, 8-to-14, 15-to-21 days, and higher in group %1G in eggs stored for 22-to-28 days.

Table 3. Embryonic mortality of various dietary groups in different storage periods

		Study groups				
	Storage period (d)	**C** **n = 458**	**Group %1O** **n = 447**	**Group %1G** **n = 660**	**Group %1GO** **n = 609**	**Total** **n =2174**
Early embryo mortality (%)	0-7 day	5,5	2,8 ^{Y}	3,6	2,4	3,3 ^{Y}
	8-14 day	5,7	5,5 ^{Y}	3,4	2,7	4,0 ^{Y}
	15-21 day	8,1	3,6 ^{Y}	5,9	4,4	5,6 ^{XY}
	22-28d ay	10,2 ^{ab}	14,2 ^{b} ^{X}	4,0 ^{a}	5,0 ^{a}	8,1 ^{X}
	Total	7,9 ^{a}	6,9 ^{ab}	4,2 ^{bc}	3,2 ^{c}	
Mid-term embryo mortality (%)	0-7 day	3,6	2,8	4,3	3,2	3,6
	8-14 day	4,5	3,7	4,6	2,0	3,6
	15-21 day	3,0	6,3	5,3	3,8	4,5
	22-28 day	1,6	5,3	4,0	5,0	3,9
	Total	3,0	4,7	4,6	3,5	
Late embryo mortality (%)	0-7 day	20,0 ^{a}	18,3 ^{a}	7,1 ^{b} ^{Z}	9,6 ^{ab} ^{Y}	11,8 ^{Y}
	8-14 day	19,3 ^{a}	16,5 ^{a}	10,9 ^{ab} ^{ZY}	6,0 ^{b} ^{Y}	12,1 ^{Y}
	15-21 day	19,3 ^{a}	14,4 ^{ab}	18,5 ^{a} ^{YX}	9,5 ^{b} ^{Y}	15,4 ^{Y}
	22-28d ay	25,8	24,8	28,9 ^{X}	23,0 ^{X}	25,6 ^{X}
	Total	21,4 ^{a}	18,6 ^{ab}	15,9 ^{b}	11,9 ^{c}	

a, b, c; Means with different superscripts within a row differ at $P < 0.05$.
x, y, z; Means with different subscripts within a column differ at $P < 0.05$.

Discussion

The fertility rates of the groups are given in Table 2. It was determined that the experimental groups had higher fertility rates ($P < 0.05$) compared to the Group C. The highest fertility rate was shown in group %1GO ($P < 0.05$). In other words, combined addition of 1% onion and 1% garlic powders to the ration positively affected fertility of chukars. Moreover, it can be concluded that onion and garlic have higher positive effect on fertility rates of partridges when given together. Balogun et al. (2017) reported in their study on quails that liquid garlic extract increased sperm quality and in-vivo fertilization potential of sperm cells. Asrat et al. (2018) found that the fertility rates of the groups given different levels of garlic powder were higher than Group C on white leghorn chickens. Okoro et al. (2016) reported that the addition of onion and garlic to the diet positively affected sperm quality of cocks and could help to increase reproductive efficiency. These literatures given above supports our findings.

When fertility rates of groups were examined according to storage times, the fertility rate of the garligroup C was shown to be negatively affected after the 21st day of storage ($P < 0.05$) which similar results could be seen in other dietary groups despite of insignificant differences. Many researchers have reported that the fertility rates of partridge eggs are resistant to the negative effects of longer storage periods which is in accordance with our results (Çağlayan et al., 2009; Gonzalez-Redondo, 2010; Günhan and Kırıkçı, 2017).

In terms of hatchability of total eggs and hatchability of fertile eggs, group %1GO had higher values than the other groups ($P < 0.05$). Asrat et al. (2018) reported that there was no difference in the rates of hatchability of total eggs and hatchability of fertile eggs between groups given different levels of garlic powder and Group C on white leghorn chickens.

According to storage times, although hatchability of total eggs and hatchability of fertile eggs was higher in the dietary groups than in C group %1On eggs stored up to 15 days, group %1G after the 14th day and group %1GO after the 21st day showed significant decreases. The hatching process (egg storage and incubation) of chicks was thought to cause oxidative stress. Thus, the enhancement of antioxidant defense during embryonic development is likely to increase hatchability (Surai, 2002). Reijrink et al. (2010) reported that there was no difference in fertility and hatchability in eggs stored for 4 and 14 days in broilers. Günhan and Kırıkçı (2017) reported that the storage period has no effect on fertility, and hatchability. Demirel and Kırıkçı (2009) shown that the storage period has no effect on fertility, and hatchability decreases as the storage period increases on pheasants. Çağlayan et al. (2009) demonstrated that there was no difference in hatchability and fertility in eggs stored in 0-to-14 days of storage periods in partridges. In our study, it can be argued that the storage period caused a decrease in hatchability and hatchability of fertile eggs after 21 days. Günhan and Kırıkçı (2017) determined the same result in rock partridges .

Early, middle and late embryonic deaths of the groups is presented in Table 3. When the feeding groups were examined in total, early and late embryonic deaths were decreased in group %1GO ($P < 0.05$), and there was no difference in the middle-term embryonic deaths. It can be said that when onion and garlic are used together in chukar rations, it contributes to the decrease of early and late embryonic deaths. Onion contains a large amount of antioxidant compound (polyphenolic) that has protective effects against different degenerative pathological phenomena (Griffiths et al., 2002). Polyphenols, sulfur compounds,

and selenium in garlic also have a strong antioxidant effect (Ağbaş et al., 2013). Li et al. (2020) stated that selenium which is an antioxidant supplementation can reduce late embryonic deaths in broilers.

Storage time also has an effect on embryonic deaths (Fasenko, 2007). Studies have shown that this effect is related to glycogen reserves (Fasenko, 2007; Christensen et al., 2011). In our study, the difference between eggs stored up to 21 days was found to be insignificant in terms of early embryonic death rates, while the highest value was obtained in group %1O with 14.2% in eggs stored 22-to-28 days ($P < 0.05$). Differences between storage groups in mid-term embryonic deaths were found to be insignificant. Late embryonic deaths were found to be higher in the C group %1On eggs stored for 0-to-7, 8-to-14, 15-to-21 days, it also was found higher in group %1G in eggs stored for 22-to-28 days. Besides, early embryonic deaths increased in the Group C and group %1O in eggs stored for 22-to-28 days. Although late embryonic deaths showed an increase in all groups in eggs stored for more than 21 days, the statistical difference ($P < 0.05$) was observed in group %1G and group %1GO. Gómez-de-Travecedo et al. (2014) reported that the 42-day storage period increased late embryonic deaths compared to the 7-day storage period, and there was no difference in other (early, mid-term) periods. Reijink et al. (2010) examined embryonic deaths in eggs stored for 4 and 14 days in broiler chickens and reported that early, middle and late embryonic deaths were higher in eggs stored for 14 days. Antibacterial, anticoccidial, antifungal, antiviral and immune-enhancing properties of allium derivative compounds and its antioxidant activity plays an important role in improving egg quality (Kothari et al., 2019). It was reported that the guercetin contained in onion (Liu et al., 2014) and garlic powder (Al-Aqil, 2016; Leke et al., 2020) increased the egg quality. It is thought that onion and garlic powder can increase the storage time in eggs due to the above-mentioned properties and increase egg quality.

The combination of onion and garlic powder produced positive impacts in terms of fertility rates, hatchability and hatchability of fertile eggs in chukar partridges. Although fertility rates are not affected by the storage period up to 28 days, hatchability and hatchability of fertile eggs are negatively affected after 21 days. With respect to embryonic deaths, onion and garlic have generally produced positive effect on reducing early and late embryonic deaths. Conversely, early and late embryonic deaths increased in eggs stored for more than 21 days.

Authors'contributions

NKA conceived and wrote the manuscript, KK and ST revised the final manuscript.

Declaration of competing interests

Authors declare that they have no financial support or relationships that could pose conflict of interest.

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