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Artigo

Carcass characteristics and some physical quality parameters of meat in male Japanese quails fed by different levels of vitamin E, sesamine and thymoquinone supplemented diets

Características de carcaça e alguns parâmetros de qualidade física da carne de codornas japonesas machos alimentados com diferentes níveis de vitamina E, sesamina e timoquinona.

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Abstract: A fully randomized experimental design, with three hundred and fifty-one days-old Japanese quails located into the seven treatment groups with five replicates and ten quail each were used in the current study. The treatments whereas the basal diet basis corn and soybean meal and (100 and 200 and) of vitamin E, sesamine and thymoquinone. At the end of the study (35 days old) two quails from each pen were selected, weighted, and slaughtered. The carcass percentage was calculated and was eviscerated, thigh, breast and abdominal fat area were removed and the weights of the mentioned organs were measured as a percentage of the organ to the total body weight. The physical analysis of the quail's meat quality was done by using two quails randomly picked from each treatment to study some qualities of their meat using the color, pH, water-holding capacity (WHC), drip loss and cooking loss parameters. Additionally, thiobarbituric acid (TBA) levels in the thigh and breast meat were measured. Data relieved from the current study showed that there were significant differences according to the thigh and breast weight and abdominal fat percentage between treatments ($p \leq 0.05$). The crude protein of tight and breast meat was increase and the ether extract content were decreased instead. Vitamin E, sesamine and thymoquinone supplemented groups were characterized by statistically higher pH values compared to the control group ($p \leq 0.05$). The significant differences across treatments in term of water holding capacity were evaluated ($p \leq 0.05$). WHC increases and drip loss and cooking loss decreased across the treatments compared to the control group. There was significant decrease for TBA value in quail's thigh and breast meat which fed by sesame and black seed oil supplemented diets ($p \leq 0.05$). In terms of the L*b*a values of the thigh and breast meat in the cold carcass, there were significant differences between the treatments ($p \leq 0.05$). In conclusion result of current study vitamin E, sesamine and thymoquinone supplemtation have some beneficial acts in live carcass weight, warm and cold

carcass percentage, thigh and breast meat proximate composition, and have no deleterious effect on meat cooking loss, drip loss, color and pH values and lead to better meat quality.

Key words: Sesamine, Thymoquinone, Meat quality, Proximate composition, Thiobarbituric acid.

Palavras-chave: Sesamina, Timoquinona, Qualidade da Carne, Composição Proximata, Ácido Tiobarbitúrico.

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Introduction

Now a day the quail rearing for meat production is becoming an economically viable activity and has increasingly developed (GENCHEV et al., 2010). From the technical and economic viewpoints, quail rearing is attractive due to their rapid growth and high reproduction rates. The carcass and meat of Japanese quail are obtained after the quail reaches 5 weeks of age (VALI, 2008). The quail meat is considered as a valuable source of protein because of its good essential and no essential amino acid profile in breast and thigh (HAMM AND ANG,1982). The quail carcass quality in one of the important factors for consuming meat in human regimes and the most important poultry meat quality attributes are appearance and texture because they most influence consumer. The meat quality is significantly affected by breeding, diets, preslaughter factors and processing (GENCHEV et al., 2008).

Vitamin E is an important biological antioxidant and may improve growth, physiological, and immunological performance by neutralizes free radicals; reduce lipid peroxidation in skeletal muscle and has positive effects on the meat quality in broiler chicks (YOUNG, 2011).

Salamatdoustnobar et al (2008) showed that using some herbal essential oil with high level of ω-3 fatty acids could

influence fatty acid profile and improved meat quality. The quality of quail meat, which is mainly affected by oxidative stress, natural ingredients, such as organic herbal compounds, have been used in the bird diet because they contain beneficial compounds with antioxidant, antifungal and antimicrobial activity (SMET et al.,2008). Sesame plant is belonging to the *Pedaliaceae* family and its scientific name is *Sesamum indicum* (ZARGARI, 2001). Black seed *Nigella sativa* originated from the Mediterranean region and it belongs to the *Ranunculaceae* family (Yarnell et al., 2011). Thymoquinone is a volatile oil and the most important active constituents of black seed that responsible for the antioxidant activity and it increases the catabolism of glucose and energy production, which ultimately lead to improve the growth (FARARH et al., 2006). Among of the natural feed additives black seed and sesame seed essential oil are very considerable for avian nutritionist, which are characterized by high amount of amino acid and good fatty acid content and their antimicrobial and antioxidant activates (ANADON,2002). Sesamin that is a bioactive phenolic compound also found in sesame. It has also been shown to possess both antioxidant and anti-inflammatory effects and could reduce serum lipid, and inhibit absorption and synthesis of cholesterol in birds (RAHIMIAN et al., 2013).

The inclusion of natural ingredients in the diet of Japanese quail such as medicinais herbal plants and seeds, has the potential to improve carcass and meat quality through reducing oxidative stress and its depends on the concentration of ingredients and on the type and conformation of the compounds present. Interestingly, according to a recent report, sesame oil may be a potentially effective natural additive to fresh meat products for prolonging shelf life during cold storage (SALLAM et al., 2021). Because of lack of data about their function on carcass traits and meat quality, the aim of current study was to determine carcass characteristics, physical quality parameters and fatty acid profile of meat in male Japanese quails fed by different levels of vitamin E, sesamine and thymoquinone supplemented diets.

Materials and Methods

The birds and the diet management

According to the fully randomized experimental design, the Japanese quails were allocated into seven treatment groups with five replicates, 10 quail each. The quails with the average weight 14.5±1.5 gr were put into cage compartments. The thermostat radiator was used to set the temperature at 33^{oC} for the

first week, and afterward the temperature was gradually reduced every week until it was set at 18-22 ^{oC}. All quails were fed for five weeks according to the NRC (1994) with (100 and 200) of vitamin E, sesamine and thymoquinone supplementation respectively. Freshwater for 24 h and the food and water were available adlibitum during the study period.

Carcass traits evaluation

In the end of the study period (35 days) two male quails from each pen were selected, weighted, and then slaughtered. The carcass percentage was calculated and the thigh meat, breast meat eviscerated and abdominal fat area was removed and measured as a percentage of the organ to the total body weight index.

Proximate composition of meat

The moisture, crude fat, and ash content percentage of quail meat were determined according to methods described by AOAC (2000).

Determination of physical parameters of meat

Using 2 quails randomly picked from each treatment to study some qualities of their meat using the color, pH, water holding capacity, drip loss and cooking loss parameters. The color of the quail breast and thigh flesh was measured using colorimeter equipment. Meat color values were assessed using agriculture and natural resources research center laboratory chronometer (L*measures comparative lightness, a* measures comparative redness, and b* measures comparative yellowness and the calibration was conducted with the black and white plates prior to actually beginning the measurement (YANG et al.,2019).

The obtained two samples of breast flesh were obtained from each subgroup at the end of the experiment, and the pH level of the breast flesh was tested at one day. On day one the meat and food pH meter was used to detect the pH level (DRANSFIELD AND SOSNICKI 1999). For evaluation the holding capacity was evaluated using a method adopted from (KISSEL et al., 2009; HAMM, 1960). Meat cubes weighing 2g were cut and laid between two filter papers circles. The weight of 10 g was placed on it for 5 minutes and afterwards, it was re weighed. The water holding capacity was calculated as initial weight minus final weight and expressed as percentage. To determine the drip loss, breast fillet samples of 10 g was remove from the carcass of the various treatments and stored in plastic trays covered with water proof foil paper and refrigerated for 24 hours (KOTULA AND WANG,1994). After that exudates were discarded and the samples were

weighed following the procedures of (NORTHCUT et al., 1994). Drip loss was calculated as initial weight minus final weight and expressed as percentage (KOMIYAMA et al., 2008).

Additionally, for determination cooking loss the samples were weighed and put in plastic bags and cooked in boiling water of about 82-85^{oC} for 10 minutes and allowed to cool on absorbent paper at room temperature. Samples were re-weighed following the procedures of (Honikel,1989). The thiobarbituric acid (TBA) was measured due the method described by (KE et al.,1997).

Statistical analysis

The obtained data were analyzed as a form of completely randomized design with seven treatments and 5 replicates by using the SAS 9.1 general linear model (GLM Procedure) techniques and the significant differences between the group's means were confirmed by Duncan,1995 method at level ($p \leq 0.05$).

Results

Proximate composition of breast and thigh meat of Japanese quail's results in Table 1 showed there were significant effect on moisture, fat and ash content in treatments ($p \leq 0.05$). The live body weight increased by using sesame and black seed oil in the quail diet. There were significant differences wth warm and cold carcass percentage ($p \leq 0.05$

Table 1-Effect of experimental treatments on proximate composition of breast and thigh meat of Japanese quails

Treatments	Moisture (%)		Crude fat (%)		Ash (%)	
	Breast	Thigh	Breast	Thigh	Breast	Thigh
Control	0.48^{b}	0.45^{b}	1.81^{a}	1.92^{a}	1.58^{d}	1.67^{d}
Vitamin E (100mg)	0.52^{ab}	0.48^{ab}	1.65^{b}	1.86^{b}	1.69^{c}	1.73^{c}
Vitamin E (200mg)	0.56^{a}	0.52^{a}	1.59^{c}	1.81^{b}	1.74^{b}	1.79^{b}
Sesamine (100mg)	0.51^{ab}	0.46^{ab}	1.62^{b}	1.88^{b}	1.75^{b}	1.81^{b}
Sesamine (200mg)	0.59^{a}	0.54^{a}	1.54^{c}	1.73^{c}	1.82^{a}	1.85^{b}
Thymoquinone (100mg)	0.53^{ab}	0.45^{ab}	1.69^{b}	1.81^{b}	1.76^{b}	1.81^{b}
Thymoquinone (200mg)	0.67^{a}	0.59^{a}	1.49^{c}	1.68^{c}	1.89^{a}	1.98^{a}
SEM	0.418	0.432	0.285	0.327	0.416	0.467
P-Value	0.0001	0.0001	0.0002	0.0001	0.0003	0.0002

The dietary treatments had significant effect on the, thigh and breast relative weight and, the significant differences were noticed decrease in the mean of abdominal fat in experimental groups ($p \leq 0.05$) Table 2.

Table 2-Effect of experimental treatments on live body, warm and cold carcass, thigh, breast weight and abdominal fat percentage

Treatments	Live body (g)	Warm carcass (g)	Cold carcass (g)	Thigh (%)	Breast (%)	Abdominal fat (%)
Control	233^{e*}	160^{d}	158de	33.3^{a}	34. 6^{d}	2.7^{a}
Vitamin E $_{(100mg)}$	241^{d}	158^{d}	154^{e}	32.5^{b}	34.3^{d}	2.3^{b}
Vitamin E $_{(200mg)}$	250^{c}	167^{c}	162de	32.6^{b}	33.8^{d}	2.1^{c}
Sesamine $_{(100mg)}$	265^{b}	176^{b}	173^{c}	32.1^{c}	35.1^{c}	1.9^{d}
Sesamine $_{(200mg)}$	274^{a}	184^{a}	180^{b}	31.5^{d}	35.8^{b}	1.6^{e}
Thymoquinone $_{(100mg)}$	258^{b}	169^{bc}	166^{cd}	31.9^{c}	34.9^{c}	1.8^{c}
Thymoquinone $_{(200mg)}$	275^{a}	191^{a}	188^{a}	31.3^{d}	36.7^{a}	1.7^{e}
SEM	0. 403	0.367	0.358	0.427	0.388	0.404
P-Value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

*a.b.c.d-Different superscripts indicate statistically differences in each column (p≤0.05).

The obtained results demonstrated that the addition of sesame and black seed oil had effect on the of the thigh and breast crude protein content (p≤0.05).

Also, significant differences were noted in the mean percentage share of the breast and thigh ether extract content (p≤0.05). Table 3.

Table 3-Effect of experimental treatments on thigh and breast crude protein and ether extract content.

Treatments	Thigh		Breast	
	Crude protein	Ether extract	Crude protein	Ether extract
Control	72.5^{c*}	26.11^{a}	68.4^{d}	25.3^{a}
Vitamin E $_{(100mg)}$	73.4^{b}	25.34^{b}	70.1^{b}	24.2^{c}
Vitamin E $_{(200mg)}$	73.2^{b}	26.06^{a}	68.3^{d}	24.4^{bc}
Sesamine $_{(100mg)}$	73.8^{b}	26.02^{a}	69.4^{c}	24.9^{b}
Sesamine $_{(200mg)}$	75.1^{a}	24.72^{c}	71.8^{a}	21.8^{e}
Thymoquinone $_{(100mg)}$	73.4^{b}	25.52^{b}	69.8^{bc}	22.8^{d}
Thymoquinone $_{(200mg)}$	75.2^{a}	24.22^{d}	72.1^{a}	22.01^{e}
SEM	0.356	0.383	0.417	0.402
P-Value	0.0001	0.0001	0.0001	0.0001

*a.b.c.d-Different superscripts indicate statistically differences in each column (p≤0.05).

Effect of experimental treatments on quality of quail's breast and thigh meat are presented in Table 3 and 4. The data showed that the sesame and black seed oil supplemented groups were characterized by statistically higher pH values compared to the control group (p≤0.05). From the results, significant differences across treatments in term of water holding capacity were evaluated (p≤0.05). Drip loss shows significant

difference across the treatment, it increases across the treatments having its least value in treatment, which it is the control group. Additionally, the cooking loss was observed to have increase in sesame and black seed treatments ($p \leq 0.05$). The thiobarbituric acid (TBA) levels in the breast meat were measured after storage at 4^{oc} for first day. Data showed there was significant decrease for breast meat TBA value in quails fed by supplemented diets with sesame and black seed oil ($p \leq 0.0$

Table 3-Effect of experimental treatments on quality of quail's breast meat

Treatments	pH	WHC (%)	TBA (mg MDA.kg)	Drip loss (%)	Cocking loss (%)
Control	6.03^{d*}	54.5^{cd}	7.84^{a}	1.98^{a}	36.8^{a}
Vitamin E (100mg)	6.06^{bc}	55.3^{c}	7.37^{b}	1.90^{b}	36.3^{a}
Vitamin E (200mg)	6.05^{c}	53.9^{d}	7.28^{c}	1.76^{d}	35.1^{b}
Sesamine (100mg)	6.08^{b}	56.4^{b}	7.22^{c}	1.81^{c}	35.8^{ab}
Sesamine (200mg)	6.06^{bc}	57.6^{a}	7.17^{d}	1.78^{c}	34.9^{b}
Thymoquinone (100mg)	6.06^{bc}	55.1^{c}	7.26^{c}	1.82^{c}	34.5^{b}
Thymoquinone (200mg)	6.12^{a}	57.5^{a}	7.16^{d}	1.72^{d}	34.2^{b}
SEM	0.306	0.355	0.374	0.365	0.310
P-Value	0.0001	0.0001	0.0001	0.0001	0.0001

*a.b.c.d-Different superscripts indicate statistically differences in each column ($p \leq 0.05$).

Table 4-Effect of experimental treatments on physical parameters of quail's thigh meat

Treatments	pH	WHC (%)	TBA (mg MDA.kg)	Drip loss (%)	Cocking loss (%)
Control	5.55^{d*}	58.5^{d}	7.44^{a}	1.94^{a}	37.4^{a}
Vitamin E (100mg)	6.09^{bc}	59.3^{c}	7.25^{b}	1.88^{b}	36.7^{a}
Vitamin E (200mg)	6.04^{c}	59.9^{c}	7.21^{b}	1.76^{c}	36.1^{a}
Sesamine (100mg)	6.11^{b}	60.4^{b}	7.16^{c}	1.82^{b}	35.5^{ab}
Sesamine (200mg)	6.08^{bc}	60.8^{a}	7.09^{d}	1.79^{c}	34.4^{b}
Thymoquinone (100mg)	6.07^{bc}	60.2^{b}	7.14^{c}	1.84^{b}	35.3^{ab}
Thymoquinone (200mg)	6.38^{a}	60.9^{a}	7.12^{d}	1.72^{c}	33.9^{b}
SEM	0.285	0.355	0.328	0.316	0.329
P-Value	0.0001	0.0001	0.0001	0.0001	0.0001

*a.b.c.d-Different superscripts indicate statistically differences in each column ($p \leq 0.05$).

The quail thigh and breast color such as L* (brightness), a* (redness), and b* (yellowness) were examined in the cold carcass and data are shown in Table 5.

In terms of the L*b*a values of the thigh and breast meat in the cold carcass, there were significant differences between the treatments ($p \leq 0.05$).

Table 5-Effect of experimental treatments on thigh and breast color in cold carcass

Treatments	Thigh			Breast		
	L*	a	b	L	a	b
Control	50.4^{a}	4.42^{d}	11.68^{d}	64.2^{a}	4.15^{d}	10.76^{cd}
Vitamin E (100mg)	50.1^{ab}	4.72^{b}	11.92^{c}	63.7^{ab}	4.09^{b}	10.71^{c}
Vitamin E (200mg)	50.5^{a}	4.36^{c}	11.79^{cd}	63.9^{a}	4.06^{c}	10.65^{d}
Sesamine (100mg)	49.2^{b}	4.99^{ab}	12.16^{b}	62.6^{c}	4.21^{ab}	10.99^{b}
Sesamine (200mg)	48.3^{c}	4.99^{ab}	12.49^{a}	61.5^{b}	4.35^{ab}	11.14^{a}
Thymoquinone (100mg)	48.8^{c}	4.59^{cd}	12.29^{b}	62.8^{c}	4.03^{cd}	11.06^{a}
Thymoquinone (200mg)	48.5^{c}	5.07^{a}	12.61^{a}	63.1^{c}	4.45^{a}	11.25^{a}
SEM	0.267	0.295	0.407	0.291	0.312	0.414
P-Value	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001

*L: Brightness, a: Redness and b: Yellowness. **a.b.c.d-Different superscripts indicate statistically differences in each column ($p \leq 0.05$).

Discussion

The researchers showed that the supplementation of broiler chicken feed with varying levels of the black seed, alone or in combination with other medicinal plants, improved dressing percentage and breast and thigh weights of the carcass, whilst at the same time reducing abdominal fat weight, compared to the control diet (NASIR AND GRASHORN, 2010 AND DURRANI et al., 2007). Rahimian et al (2013) indicated that use of sesame meal in the diet of broilers have beneficial acts on carcass components and decrease abdominal fat percentage of the birds. Asghar et al (2022) showed that the dietary treatments had no effect on the live weight, cold carcass weight, and carcass efficiency.

However, significant differences were noticed in the mean hot carcass weight between groups ($p \leq 0.05$).

Adedji et al (2019) have indicated that growth performances, carcass characteristics, primal cuts and organs' weights were significantly affected by sesame. They also showed that sesame treatments were superior in respect to neck, shank, thigh, drumstick and breast weights

than other. Kumar et al (2018) showed that the quails given a feed enhanced with black seed had larger breast and thigh weights as well as a higher dressing percentage compared to the control ($p \leq 0.05$). Khan et al (2012) also found that the value of the dressing percent was enhanced in the highest fed black seed addition group.

Nikolakakis et al (2014) showed that the carcass dressing percentage, meat percentage, and meat chemical composition did not differ between the groups that fed by seed hulls. They also mentioned that the meat resistance to lipid oxidation after 3 days of refrigeration, measured as thiobarbituric acid reacting substances (TBARS), was not affected. The results indicated that the black seed and sesame seed oil antioxidant capacity was efficient in avoiding oxidation in the quail breast flesh. This suggests the utility of the peroxide value as a quick and sensitive method for detecting changes in quail meat storage deterioration. Data revealed form current study are in line with the (Asghar et al., 2022) who reported that the lower thiobarbituric acid (TBA), pH, peroxide, and total psychrophilic bacteria levels were found in the black cumin seed added groups compared to the control group ($p \leq 0.05$). In the current study, higher pH values were observed in the powder group, potentially because of the antioxidant effects of vitamin E, sesamine and thymoquinone.

Zhang et al (2012) reported that the similar findings in a previous study that the antioxidant a-tocopherol succinate increased meat pH compared with the control. One of the most important physiological factors influencing drip loss is the extent of the post-mortem decreases in pH. A lower muscle pH after death results in higher drip loss due to the lower ability of muscle proteins to bind water and greater myofibrillar shrinkage brought about by reduced electrostatic repulsion between filaments (KIM et al.,2009). Rahman and Kim (2016) mentioned that the sensory meat characteristics and pH values of the breast meat were reduced in different black seed treatments when compared to the control ($p \leq 0.05$).

Mahbubur et al (2016) reported that with an increase in dietary black seed and vitamin E supplementation, the pH values increased and there were significant differences in lightness in thigh muscle between all treatments compared to the control group ($p \leq 0.05$). Increasing the lightness of meat and decreasing redness might be associated with an increase in met myoglobin formation due to oxidation of myoglobin and furthermore, the presence of antioxidant compounds in natural extracts could retard metmyoglobin formation in meatballs and decrease lightness values (FERNANDEZ-LOPEZ et al. 2005).

Aksu and Kaya (2005) found that in the absence of antioxidants, meat had a lower redness value and antioxidant supplements protect against tissue damage by preventing the formation of radicals and scavenging them, by promoting their decomposition, resulting in better meat color. Azzem et al., (2014) found lower MDA and higher antioxidant activities in the black seed and vitamin E treated groups than the control one. Adam et al., (2016) showed that the black seed essential oil has the ability to inhibit lipid peroxidation and act as superoxide anion scavengers. Inclusion of NS seeds in the diet resulted in a significant decrease in erythrocyte alondialdehyde (MDA) concentration, production of lipid peroxidases and increased glutathione concentration in chickens.

Conclusions

According to the result of current study, vitamin E, sesamine and thymoquinone supplemtation in the diet of Japanese quails have some beneficial acts in carcass traits and composition. In conclusion, we could demonstrate that the vitamin E, sesamine and thymoquinone have beneficial acts on meat quality without deleterious effect on their cooking loss, drip loss, color and pH values. Therefore, the future studies are needed for more explanation.

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