

## The Effects of Different Slaughter Ages and Gender on Some Meat Quality Characteristics, Texture and Sensory Evaluation Values in Japanese Quails

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### ABSTRACT

The aim of this study to determine the effects of different slaughter age and gender on some meat quality characteristics, texture and sensory analysis values in quails. For this purpose, carcasses of Japanese quails of different sexes and different slaughter ages (4 and 8 wks ) were obtained from a private enterprise. These carcasses were brought to the laboratory under the cold chain. Analyzes were performed 24 hours after slaughter. Colour, cooking loss, and texture analysis were performed on the left side of skinless breast meat in carcasses. pH and electrical conductivity were determined in the right part of breast meat. Leg meats were used for sensory analysis. While the gender factor created a significant difference in the pH value ( $p<0.05$ ) and flavor score ( $p<0.05$ ) of quail meat the slaughter age had a significant difference both in the pH value ( $p<0.001$ ) and the color values ( $a^*$  and  $b^*$  values;  $p<0.05$ ). The difference between the groups in the texture values of breast meat was not statistically significant. In the sensory analysis evaluation, it was determined that only the difference between the groups in the flavor score of the gender factor was significant ( $p<0.05$ ).

**Key words:** Gender, Japanese quails, meat quality, sensory evaluation, slaughter age

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### Japon Bildircinlerinde Farklı Kesim Yaşı ve Cinsiyetin Bazı Et Kalite Özellikleri, Tekstür ve Duyusal Değerlendirme Değerlerine Etkisi

### ÖZ

Bu çalışmanın amacı, farklı kesim yaşı ve cinsiyetin bildircinlerde bazı et kalite özellikleri, tekstür ve duyusal analiz değerleri üzerindeki etkilerini belirlemektir. Bu amaçla özel bir işletmeden farklı cinsiyette ve farklı kesim yaşlarında (4 ve 8 haftalık) Japon bildircinlerinin karkasları temin edilmiştir. Bu karkaslar soğuk zincir altında laboratuvara getirildi. Analizler kesimden 24 saat sonra yapılmıştır. Karkasta derisiz göğüs etinin sol tarafında renk, pişme kaybı ve tekstür analizleri yapıldı. Göğüs etinin sağ kısmında pH ve elektrik iletkenliği belirlendi. Duyusal analiz için bacak etleri kullanıldı. Cinsiyet faktörü bildircin etinin pH değerinde ( $p<0,05$ ) ve lezzet skorunda ( $p<0,05$ ) anlamlı bir fark yaratırken, kesim yaşı hem pH değerinde ( $p<0,001$ ) hem de renk değerlerinde ( $a^*$  ve  $b^*$  değerleri;  $p<0,05$ ) önemli bir fark oluşturmuştur. Göğüs etinin tekstür değerlerinde gruplar arasındaki fark istatistiksel olarak anlamlı değildir. Duyusal analiz değerlendirmesinde sadece cinsiyet faktörünün lezzet puanında gruplar arasındaki farkın anlamlı olduğu belirlendi ( $p<0,05$ ).

**Anahtar kelimeler:** Cinsiyet, duyusal değerlendirme, et kalitesi, Japon bildircinleri, kesim yaşı

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## INTRODUCTION

While the production of poultry meat was 68.64 million tons in the 2000s, it reached 132.39 million tons in 2019 (Ritchie et al. 2019). This great increase in production shows the importance of the share of the poultry industry in meeting the protein source demand of the increasing population. In addition to being a protein source with high biological value like other meat products, it is noteworthy that especially iron and zinc minerals have high bioavailability from red meat (Barroeta 2007).

Although chicken meat has the largest share in the sector as a source of poultry meat, quail meat has gained importance in recent years. In particular, Japanese quails have been up-to-date economically for meat and eggs in the commercial poultry industry. The fact that it is put on the market more for consumption at the age of 5 weeks, it reaches early sexual maturity, and the need for lower feed and space requirements than domestic poultry are among the factors that increase its importance (Hrncar et al. 2014). Japanese quails are mostly fed for eggs in the Southeast of Asia, while it is fed for both meat and eggs in Europe and America. (Minvielle 2004).

The chemical composition of Japanese quail carcasses (at 35 to 42 days of age) is 68% water, 19% protein, 10% fat, and 3% mineral (Genchev et al. 2008; Vargas-Sanchez et al. 2019). The thin skin of quail meat and the low amount of fat between the tissues may make it recommended for a low-fat diet. It is also easy to present and not difficult to cook (Abou-Kassem et al. 2019).

Breed, gender and slaughter age are among the factors that are effective in determining the meat quality of poultry (Flecher 2002). Among these factors, gender and slaughter age can affect the desired body weight, completion of muscle development, development of muscle content (muscle fat distribution), reaching organoleptic structure, and also the characteristics used in technology (Poltowicz and Doktor 2012).

The factors that affect the consumers' choice of poultry meat and then their satisfaction are primarily its appearance and texture. In the appearance, bruises and hemorrhagic areas may be noticed along with the color. Myofibrillar protein denaturation, connective tissue content and juiciness level of meat are effective in texture development (Flecher 2002; Nusairat et al. 2022).

In a study evaluating carcass characteristics and meat quality of Japanese quails of different genders and different slaughter ages (5, 6, 7 weeks); It has been reported that the tenderness, fat content, and L value of the meat of female animals are higher, while the redness and water holding capacity values of the meat are lower. It has been reported that with increasing slaughter age, the juiciness and tenderness of the meat decrease, the water holding capacity, the amount of

intramuscular fat, and the redness of the meat increase (Abou-Kassem 2019).

Lukanov et al. (2021) in their study in which they examined the pH and color values in the breast muscle of meat-type quail (WG line), it was reported that the pH value was 5.75-6.26 and it was not affected by the slaughter age (28, 35 and 42. days) and gender differences. It has been also added that the biggest change in the color values of the meat is in the brightness value of the meat ( $L^*$ ), and the brightness decreases with increasing age. In the same study, it was stated that while the redness value ( $a^*$  5.77-11.6) decreased with the increase in slaughter age, the yellowness value ( $b^*$ : 5.14-11.13) increased. It was stated that redness in female quail meats and yellowness in male quails were more pronounced.

In another study that examines the effects of different slaughter ages (33-42 days) on meat quality values in Pharaoh quails, which have a larger body weight than other quail birds, it was stated that pH15 values and water holding capacity were higher at the slaughter age of 42 days. In the color values, it was stated that the brightness of the meat was high in quails slaughtered on the 33rd day, and the redness and yellowness values increased in the elderly quails. It has been reported that the taste, juiciness, tenderness, and flavor intensity values, which are especially desired from the sensory properties of the breast meat at the age of 33 days, are higher and the aroma intensity is lower (Wilkanowska and Kokoszyński 2011).

In this study, the effects of different slaughter ages and gender on some meat quality characteristics, texture, and sensory analysis results were investigated in Japanese quails.

## MATERIAL AND METHODS

### Raw Material

This study was conducted in November 2022. For the experimental study, quails raised under the same conditions until the desired slaughter age were obtained from a local commercial farm after they were slaughtered (after 4 hours of antemortem fasting) the mechanical system (decapitation, after bleeding, plucking, and evisceration). After slaughtering, the carcasses were brought to the laboratory at +4 °C without breaking the cold chain. For the study, a total of 28 quail carcasses of different sexes and different slaughter ages (7 females -7 males, 4 wks; 7 females-7 males 8 wks) were obtained.

Meat quality and texture analyzes were performed 24 hours after slaughter. Sensory evaluations were performed 48 hours later. Carcasses were kept in refrigerator conditions (+4 °C) until analysis. Color, cooking loss and texture analysis were performed on the left skinless pectoralis major muscle. pH and electrical conductivity were determined in the right

pectoralis major muscle. Leg meats were used for sensory evaluation.

### pH and Electrical Conductivity Measurement

For the analysis, 10 g samples were taken from the skinless breast meat of quails and homogenized. 100 ml of distilled water was added to it. The pH (AD110 pH-Temp, Adwa, Hungary) and electrical conductivity (Orion Star A222, Thermo Scientific, Korea) of the prepared samples were measured. Measurements were made 24 hours after slaughter.

### Meat Color

A Chroma meter (Konica Minolta, CR-400, Japan) was used to make breast meat color measurements. Measurements were taken from 3 different points of the quail skinless breast meat and average values were taken. L\*(lightness), a\* (redness), and b\*(yellowness) values were calculated.

### Cooking Loss

To calculate the cooking loss, 5 g of quail breast meat was weighed. Samples were placed in polyethylene bags. It was kept in a water bath (Selecta, Spain) of 80 °C for 1 hour until the internal temperature was 70 °C. After room temperature cooling, the weighings were made. Cooking loss was calculated as a percentage by taking the weight differences before and after cooking (Honikel 1998).

### Texture Analyses

For texture analysis, breast meat samples were prepared as 1 cm x 1 cm x 2 cm. Samples were measured using the texture analyzer (CT3 Texture Analyzer; BrookfieldEngineering Labs Inc., Middleborough, MA, USA) according to the modification of the method described by Masoumi et al. (2022). Probe model TA44.

### Sensory Evaluation

Sensory evaluation panelists (10 people) consisted of senior students of the Nutrition and Dietetics department. Before the analysis, the students were

given training on the conduct of the sensory evaluation. For sensory evaluation, quail legs were cooked in the oven at 200°C until the internal temperature was 80°C by adding only salt. It was then presented to the panelists on plastic plates. In the forms distributed to the panelists, they were asked to evaluate the desired features (smell, colour, flavor, tenderness, juiciness, fibrous, chewability and general appreciation etc.) with numbers from 1 to 9. Very good (8 - 9), Good (6 - 7), Fair (4 - 5), Poor (2 - 3), Very poor (0 - 1) (Frag et al. 2021).

### Statistical Analysis

After controlling for the normal distribution of the data two-way ANOVA test was used for the effect of slaughter age and gender in determining the difference between the groups. The sample size used in the study was determined with the G Power 3.1 power analysis software (Faul et al. 2007). The statistical analysis was performed by means of the SPSS Statistics 23.0 package software.  $p < 0.05$  was taken into account statistically.

## RESULTS

Some meat quality values in quail breast meats are given in Table 1. Electrical conductivity values of young females and males quail meats were measured as 1182.43 and 1164, respectively. Elderly females and males quail meats electrical conductivity values were determined as 1164 and 1185. It was determined that there was no statistically significant difference between the groups in terms of gender and slaughter age.

pH values were 5.86 and 5.73 in young and old female quails meats, respectively; it was measured as 5.92, 5.78 in young and old men quails meats. It was determined that the factors of gender ( $p < 0.05$ ) and slaughter age ( $p < 0.001$ ) created statistically significant differences between the groups.

**Table 1.** Some meat quality values in quail breast meat

Gender	Age	Electrical conductivity	ph	Cooking loss (%)	L* Lightness	a* Redness	b* Yellowness
Female	4 wk	1182.43±142.664	5.864±0.086	26.897±2.70	57.98±4.44	7.48±1.30	5.61±1.62
	8 wk	1164.00±34.225	5.731±0.070	27.605±3.93	54.27±2.25	8.79±2.07	4.17±0.62
Male	4 wk	1233.57±299.163	5.92±0.064	26.732±4.01	56.78±1.32	7.59±0.98	5.14±0.59
	8 wk	1185.71±88.153	5.78±0.062	30.748±1.57	57.46±2.86	9.35±2.18	4.93±0.82
P							
Gender		0.581	*	0.232	0.382	0.611	0.698
Age		0.616	**	0.064	0.188	*	*
Interaction		0.823	0.938	0.186	0.061	0.735	0.120

Values are shown as mean±SEM. \*:  $p < 0.05$ ; \*\*:  $p < 0.001$ .

Cooking loss values were determined as 26,73 and 30,74% in young and old male quail breast meats, respectively. It was determined that both slaughter age and gender did not differ between the groups.

Brightness value ( $L^*$ ), which is one of the important values in meat quality, decreased in samples taken from females and increased in samples taken from males as slaughter age increased. But these differences are not statistically significant. Among the color values, it was determined that the redness value ( $a^*$ )

increased with increasing slaughter age in both females and males quail meats ( $p < 0.05$ ). It was determined that the difference in genders was not significant in the  $a^*$  value. The yellowness value ( $b^*$ ) in breast meat samples was 5.61 and 4.17 in young and old females quail, respectively; 5.14 and 4.93 in young and old men quail. The decrease in  $b^*$  value with the prolongation of slaughter age in both genders was found to be statistically significant between the groups ( $p < 0.05$ ).

**Table 2.** Texture analysis values in quail breast meat

Gender	Age	Hardness (N)	Adhesiveness (mj)	Cohesiveness	Springiness (mm)	Gumminess (N)	Chewiness (mj)
Female	4 wk	4.687±0.86	0.608±0.52	0.488±0.246	8.052±1.917	2.497±1.43	11.70±3.44
	8 wk	5.451±0.89	0.631±0.16	0.312±0.220	6.231±1.510	1.201±0.42	8.380±4.30
Male	4 wk	4.835±1.61	0.668±0.566	0.324±0.133	7.477±1.138	1.527±0.69	11.960±7.00
	8 wk	4.747±0.65	0.870±0.780	0.355±0.136	7.222±1.320	1.687±0.55	12.201±4.42
		P					
Gender		0.499	0.484	0.409	0.717	0.470	0.289
Age		0.412	0.598	0.328	0.080	0.097	0.421
Interaction		0.302	0.674	0.165	0.180	0.037*	0.353

Values are shown as mean±SEM. \*:  $p < 0.05$

The texture values of quail breast meat are given in Table 2. Hardness values were measured as 4.68 and 4.83 N in young females and males quails, respectively. In elderly females and males quails, it was determined as 5.45 and 4.74 N, respectively. Although the adhesiveness value was numerically higher in the samples obtained from male quail, it was determined that this difference was not statistically significant. It was determined that both the slaughter age factor and the gender factor did not create a

significant difference between the groups in the cohesiveness value. It was also determined that the springiness feature was higher in the young quail (8.05; 7.47 mm;  $p > 0.05$ ). Although the effect of gender and age factor on the gumminess value was not significant, the interaction between the two characteristics was found to be significant ( $p < 0.05$ ). The chewiness value did not differ between the groups.

**Table 3.** Sensory analysis values in quail leg meat

Gender	Age	Colour	Smell	Flavor	Tenderness	Juiciness	Fibrous	Chewiness	Overall liking
Female	4 wk	6.40±1.34	6.00±1.94	6.90±1.10	7.30±1.76	6.30±2.21	7.00±1.15	7.60±1.89	6.20±1.47
	8 wk	6.30±1.41	6.00±1.56	6.50±1.26	6.90±1.52	6.10±2.28	7.10±1.37	7.30±1.05	6.50±1.64
Male	4 wk	6.70±1.33	6.20±1.54	7.60±1.07	7.80±0.78	6.70±2.00	7.60±0.84	8.40±0.69	6.80±1.81
	8 wk	7.70±1.33	7.30±1.33	7.70±1.63	7.10±1.85	6.60±1.95	7.00±1.76	7.30±1.94	7.40±1.64
		P							
Gender		0.056	0.288	*	0.477	0.506	0.555	0.405	0.159
Age		0.303	0.150	0.715	0.267	0.824	0.555	0.149	0.394
Interaction		0.210	0.288	0.544	0.760	0.941	0.409	0.405	0.775

Values are shown as mean±SEM. \*:  $p < 0.05$ .

Sensory analysis results in quail leg meat are given in Table 3. Although leg meat samples obtained from male elderly quail were more appreciated in terms of color and smell, these differences were not statistically significant. Flavor values were calculated as 7.60 and 7.70 for young and elderly male quails, respectively. In the samples obtained from female quail, these values were observed to have lower scores. Differences between the groups due to the gender factor were significant ( $p < 0.05$ ). Although tenderness, juiciness, and chewiness values were more appreciated in samples obtained from young quail, these differences were not statistically significant. It was determined that the gender and age factors were

not important in the fibrous value. Although meat samples obtained from elderly and male quail received higher scores as overall liking, it was determined that these differences were not statistically significant.

## DISCUSSION

Quality is one of the important factors in meat production. At the same time, it is a priority for the consumer and ensures the sale of the product. pH and color values are important in determining the quality of meat (Qiao et al. 2001). In this study, it was determined that the effects of gender and age factors

were important in pH measurements made in *M. pectoralis superficialis* muscle in quails. It was measured that the pH value was higher in the samples obtained from young and males. In a study, it was reported that the pH value of breast meat was lower in female broilers 24 hours after slaughter. Depending on the gender difference, the glycolysis that develops in the postmortem period and the resulting difference in the accumulation of lactic acid in the muscles may cause this (Lopez et al. 2011). While the color values were not affected by the gender factor, it was determined that the effect of slaughter age on the redness ( $a^*$ ) and yellowness ( $b^*$ ) values of the meat was significant. The redness value was higher in the samples taken from the elderly and the yellowness value in the samples taken from the young.

In a study in which the effects of different slaughter ages (35-42 days) and gender on meat quality in quails were determined, it was reported that the pH<sub>24</sub> value in male carcass meats was lower than the female carcass values. It has been also reported that the redness value is lower in female carcass meats at 35 days of age; and that the carcass characteristics of male quails at 42 days of slaughter are also better (Abreu et al. 2014).

Wilkanowska and Kokoszyński (2011) reported in their study on the effect of different slaughter ages (33-42 days) on meat quality in Pharaoh quails with large body weight; that the pH<sub>15</sub> value was higher at the slaughter age of 42 days.

Petek et al. (2022), in their study on female quails of different genotypes and different slaughter ages (60-270 days), it was stated that the pH value was significantly higher in old quail carcasses and  $a^*$  and  $b^*$  values were significantly higher in meat samples of young quails. It has also been reported that a low pH value reduces the water-holding capacity.

In another study, in which different slaughter ages (8 weeks and 8 months) were applied, it was stated that the brightness value ( $L^*$ ) was high, and the  $a^*$  and  $b^*$  values were low in the meat of young quails. It has been stated that the pH value is higher in aged quail meats. In the same study, it was stated that the reason why quail meat is darker and redder than other poultry meat may be due to the increase in myoglobin pigment with increasing age (Boni et al. 2010).

In a study examining the meat quality values of quail carcasses with slaughter age greater than 45 days and less than 45 days, it was reported that there was no difference between the groups in terms of pH value and cooking loss. In addition, it has been reported that a low pH value may cause poor water capacity of myofibrillar muscle proteins, resulting in high cooking losses (Awan et al. 2017).

Unlike this study, Lukanov et al. (2021) reported that the effect of slaughter age (28; 35, and 42 days) and gender on the pH value was not significant.

The texture values of meat are an important factor for the consumer's purchasing preference. In this study, it was determined that the effects of both gender and age were not significant on quail breast meat texture values. The fact that the difference between the slaughter age groups was not high may have been effective in this.

Unlike this study, Abou Kassem et al. (2019) It has been reported that in Japanese quails of different slaughter ages (5, 6, and 7 wk) and different genders, the juiciness and tenderness values in meat decrease with the increase in slaughter age. It was stated that the gender factor was important only in the softness value in meat and this value was high in female quails. In another study, it is stated that the softness of meat decreases with age, and this may be due to the increase in fiber diameter, connective tissue, and cross-links between polypeptide chains (Reddy et al. 2017).

The sensory properties of meat, like the texture properties, play an important role in consumer preference. In a study in which different slaughter ages (33 and 42 days) were applied, it was reported that while quail carcasses slaughtered for 33 days had higher scores in sensory characteristics such as juiciness, tenderness, flavor intensity, and desirability, they scored lower in aroma intensity (Wilkanowska and Kokoszyński, 2011). In another study, it was stated that the flavor components were generally related to the fat content and the components increased with the prolongation of the cutting age (Reddy et al. 2017).

In this study, it was determined that there was no significant difference between age and gender in sensory characteristics. It was determined that only the effect of the gender factor on the flavor factor was significant and the meat of male quail scored higher. In this regard, It may be that the musculature of male animals is better than females of the same age genetically, which affects the development of flavor factor and texture development.

## CONCLUSION

As a result, in this study, it was determined that the effect of different slaughter age factors on pH and some color values ( $a^*$  and  $b^*$ ) was significant, while the effect of gender factors on pH and sensory characteristics only on flavor score was determined. The low difference between the slaughter ages in this study may have been effective in the similarity in the data obtained from the groups.

At the same time, when evaluated in terms of similar factors, it is important result that the results of texture analysis and sensory analysis support each other.

**Conflict of interest:** The authors have no conflicts of interest to report.

**Authors' Contributions:** ÖVA contributed to the project idea, design and execution of the study. ÖVA and EY contributed to the acquisition of data. ÖVA analysed the data. ÖVA drafted and wrote the manuscript. ÖVA reviewed the manuscript critically. All authors have read and approved the finalized manuscript.

**Ethical approval:** “This study is not subject to the permission of HADYEK in accordance with the “Regulation on Working Procedures and Principles of Animal Experiments Ethics Committees” 8 (k). The data, information and documents presented in this article were obtained within the framework of academic and ethical rules.

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