Journal of Research in Ecology

An International Scientific Research Journal

ISSN No: Print: 2319 –1546; Online: 2319-1554

Original Research

# Relationships between pectoralis muscle growth and meat quality issues in Japanese quail

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**ABSTRACT:**

The improvement of the meat quality, because of some important factors, namely consumer preferences and the industry demands, has become a top priority lately. Selection of performance traits induced several changes in quail meat quality. Therefore, there are three significant factors to be considered while selecting the quail meat type: the growth performance, carcass parts, and improved meat quality. In this study a Japanese quail population was used to estimate the genetic parameters of body weight and carcass traits at 42 days of age. The studied population consisting of 368 quail were selected for 42 days body weight up to seventh generation. Multivariate analysis were used to estimate heritability, genetic and phenotypic correlations among all combinations of traits. Estimated parameters were obtained using the restricted maximum likelihood method (Wombat) software. Two types of quail (with high and low breeding value) were used in the experiment. Then meat quality traits of pectoralis muscle (pH and temperature, water holding capacity, water absorption capacity, drip loss, cooking loss and meat colour) were measured between two groups. In this study, the results of the quantitative and qualitative characteristics for 368 birds found that the average of water holding and absorption capacity, drip loss and primary pH were lower than the reported values. But average values of L * and b * were higher. Thus it can be concluded that selection for increased productive for weight gain at 42 days of age may be a reason for the decrease of water holding capacity and increase in colour characteristics.

**Keywords:**

Breeding value, Japanese quail, Meat quality

**Article Citation:**
**Ehsan Nasirifar , Mokhtar-Ali Abbasi, Naser Emam Jome kashan, Mehdi Aminafshar and Masoud Sami**
Relationships between pectoralis muscle growth and meat quality issues in Japanese quail
**Journal of Research in Ecology (2016) 4(1): 056-064**

**Dates:**
**Received:** 16 May 2016 **Accepted:** 21 May 2016 **Published:** 30 June 2016

## INTRODUCTION

Japanese quail (*Coturnix japonica*), which is raised in many countries in Asia (especially the Middle East), Europe and the US, is used as an animal model, and provides good sources of eggs and meat (Ribarski and Genchev, 2013). Much research is conducted to improve growth because Japanese quail respond quickly to selection for the body weight (Narinc *et al*., 2013). Also, poultry meat is rich in Poly Unsaturated Fatty Acids (PUFA), and low sodium and cholesterol content. Due to containing bioactive substances which are supposed to be useful for human health, vitamins, antioxidants, Ω 6 and Ω 3 PUFA, and conjugated linoleic acid, poultry food is a suitable source for what is known as "functional foods" (Ribarski and Genchev, 2013).

The Japanese quail meat deboned manually is proved to contain 72.5–75.1% water, 20-23.4% protein, 1.0–3.4% lipids and 1.2–1.6% mineral substances. The one deboned mechanically, however, contains 17% protein, 10% fat and 2.6% minerals. In comparative studies on physiochemical properties of ducks, broil chicken, and quail meat, it was proved that the quail meat contained the lowest-calorie meat with the highest protein level (Ribarski and Genchev, 2013).

The improvement of the meat quality, because of such important factors as consumer preferences and the industry demands, has become a top priority lately (Le Bihan-Duval *et al*., 2003). Moreover, some studies have been conducted to improve carcass composition and feed conversion. Selection of meat-type quails focused not only on growth performance and carcass parts but also on the improved meat quality. Biological characteristics (mainly genotype, productivity, sex and age), as well as environmental and technological characteristics (composition and nutritional level of diet, rearing, transport and slaughter) account for variation in the meat quality. It is the interaction among these parameters which results in a high variability of muscular structure, shaping the qualitative characteristics of meat (Roncada *et al*., 2010). Therefore, the meat quality is dependent on the interactions between the genotype of an animal and the environment in which it lives (Narinc *et al*., 2013).

Selection in meat poultry has resulted in a very large increase in growth rate, carcass yield and reduction in fatness. Poultry breeders have predominantly focused on selection for increased yield of breast in response to the consumers' desire. However, despite increases in breast meat yield, little is known about the consequences of such selection on the quality of the meat. Selection for performance traits may induce several changes in quail meat quality, which has been recognized as one of the main factors to be considered by the poultry industry. Researchers described that changing growth rate, fatness or yield also modified the growth, structure or overall metabolism of muscle, resulting in alterations affecting the technological or sensory properties of the meat (Zerehdaran *et al*., 2013).

Meat quality is one of the economically important traits in the poultry industry. The major determinants of meat quality consisted of toughness, tenderness, juiciness and flavor. Moreover, the tenderness and toughness traits are a major aspect of consumption quality among consumers (Teltathum and Mekchay, 2010).

The growing concern on the part of the consumers concerning the food quality, particularly that of meat, had a lot to do with the present paper researchers' inclination whose aim was to conduct a more detailed analysis of the characteristics of Japanese quail meat quality.

## MATERIALS AND METHODS

### Data collection

A Japanese quail population was used to estimate the genetic parameters of body weight and carcass traits at 42 days of age. The studied population consisting of 368 quail that are reared in the poultry research station of Meybod in Iran, were selected for 42 days body weight for seven generation. In the seventh generation, the birds were randomly selected and the sires and dams for each bird were identified. The same diet for the birds were applied. The birds after six hours of feed withdrawal were weighed individually (Body Weight), slaughtered (by cutting the throat, jugular veins) and allowed to bleed. The feathers were removed by hand plucking. Then multivariate analysis were used to estimate heritability, genetic and phenotypic correlations among all combinations of the traits. Estimated parameters were obtained using the restricted maximum likelihood method (Wombat) software (Meyer, 2007). Two types of quail (with high and low breeding values) were used in the experiment.

**Carcass pH and temperature measurements**

The pH and temperature of the carcasses were monitored using a Testo 206 pH/temperature meter (accuracy ±0.02) with a piercing pH electrode and temperature probe (Testo 206, Germany, 0560 2060, 30001478/407). The pH meter was calibrated at room temperature before each measurement. Measurements were recorded post slaughter min 20 (pH1) and post slaughter hour 24 (pH2) in pectoral muscles at the location of one third upper of the breast. Then carcasses were put in a refrigerator (2-4°C) for 24 hours. Afterwards, chilled carcasses were measured with a pH/ temperature pH meter. For each measurement, the pH and temperature probes were inserted into muscles with a similar depth (2 cm).

The hydrophilic properties of meat were determined through the parameters Water Holding Capacity (WHC) and Water Absorption Capacity (WAC) and cooking and drip loss percentage.

**Water Holding Capacity (WHC) measurement**

The Water Holding Capacity (WHC) of longissimus dorsi was estimated on the muscle samples. Frozen samples were taken out of the freezer and placed at the room temperature. Briefly, two gram of meat samples were collected from the identical places. The samples were placed on the Whatman filter paper number two and centrifuged for four min at 3335 rpm in a stainless steel tube. The juice released from the meat was decanted off as quickly as possible in order to avoid re-absorption of water. The meat sample was removed from the tube, dried with tissue paper, and then reweighed to determine liquid loss. After centrifugation the samples were dried with linen fabric and consequently weighted. Then the samples were placed into the oven for 24 hours at 70° and consequently weighted (Castellini *et al*. 2002).

$$\%WHC = {WAC - WAO}/_{WBC} \times 100$$

WAC= Weight After Centrifugation

WAO= Weight After Oven

WBC= Weight Before Centrifugation

**Water Absorption Capacity (WAC)**

The WAC of meat was measured in isotonic physiological saline. For this purpose, one sample of approximate size of 2.0×1.0×0.5 cm was obtained from the pectoral muscles which weighed 0.001 gram exactly, and was put in tubes containing 15 ml physiological saline. Having been left for 24 hours at 2-4°C, the meat pieces were removed from tubes, carefully dried on a filter paper from superficial water and weighed on the same scales once again.

The WAC of meat was calculated as:

$$WAC = \left(\frac{B - A}{A}\right) 100$$

Where:

Weight of the piece of meat,

A - Prior to analysis

B - After a 24 h stay in physiological saline (Genchev *et al*., 2010).

**Cooking loss**

This method which involves heating the core of sample as high as 80° C for 10 min in a forced

$$Cooking\ Loss = \frac{Intial\ Weight\ (g) - Final\ Weight\ (g)}{Initial\ Weight\ (g)} \times 100$$

convection oven, determines the cooking loss percentage of the breast meat (Bertrama *et al*., 2003).

**Drip loss**

Drip loss percentage of breast muscle was determined. The samples of approximate size 2.0×1.0×0.5 cm were obtained from the pectoral muscles. They were weighed with a precision of 0.001 g, and put in linen fabric, and kept at 4°C in a refrigerator for 24 hours and then dried and consequently weighted (Christensen, 2003).

$$Cooking\ Loss = \frac{Intial\ Weight\ (g) - Final\ Weight\ (g)}{Initial\ Weight\ (g)} \times 100$$

**Meat colour measurement**

Meat colour of longissimus dorsi was measured on the samples for 30 min after slaughter. Colour values L*(lightness: 100 represents white and 0 represents black), a* (redness-greenness: positive represents red and negative represents green), and b* (yellowness-blueness: positive represents yellow and negative represents blue) were determined with a simple digital imaging method described by Yam and Papadakis (2004), with a slight modification. Samples were allowed to bloom for 30 min at room temperature prior to the colour measurement. A Canon colour digital camera (14 mega pixels of resolution, Japan) installed at a 30-cm constant distance from the sample surface was used for taking digital images. The lamp and the camera were placed in a box (50 × 50 × 60 cm) with interior white walls. The angle between the axis of the camera lens and the sample surface was 90°. The angle between sample surface and light source was 45°. Illumination was achieved using a 20-W fluorescent light lamp. The digital images of samples were analyzed in the Lab mode to obtain L*, a*, and b* colour parameter using the Photoshop version 8.0. Colour was evaluated by obtaining three measurements per sample, which were then averaged to obtain a mean value for L*, a*, and b* for each muscle sample (Abbasvali *et al.,* 2012). The Chroma (C*) and Hue angle (h°) were calculated on the basis of a* and b* values (Genchev et al. 2010).

$$Chroma(c^*) = \sqrt{a^{*2} + b^{*2}}$$

Hue angle (h˚) = $tg^{-1}$(b*/a*)

**RESULTS AND DISCUSSION**

**Description of Traits**

The descriptive statistics of the traits are presented in (Table 1). The comparison of paternal families with low and high average breeding value for the quantity and quality traits are given in Table 2.

**pH**

Immediately after slaughtering, meat pH of all samples were ranged from 4.4-5.8 with an average of 5.0 and 24 hours after slaughtering were ranged from 4.3 -5.3 with an average of 4.7 for pectoral muscles (Table 1). pH values of the studied muscles as well as their equivalent breeding values are listed in (Table 2). There were no statistically significant differences between high and low groups of quails.

The pH of meat is one of the most important traits for poultry meat quality. It is established that this trait changes most dramatically during the first hours after the slaughter. This is a period of most enhanced glycolysis and lactate accumulation into the muscle tissue. The rate of these processes and the lowering of skeletal muscle pH in the early post slaughter period are essential for meat quality (Ribarski and Genchev, 2013).

Low pH values during the first post mortem hours, not only affects the WHC, but also influences some other organoleptic properties of meat including colour, tenderness, juiciness, etc. Following pH values have reached the isoelectric point of myofibrillar proteins, which is between pH 5.2-5.4, shrinkage of the protein network happens, accompanied by drop of meat WHC. Protein matrix shrinkage is associated with attachment and fixation of bivalent ions ($Ca^{2+}$ and $Mg^{2+}$) to negatively charged protein areas, which also results in

**Table 1. Number of observations (n), mean, SD, CV, minimum (MIN) and maximum (MAX) values of meat quality traits.**

| Trait | Sex | N | Mean | Total Number | Total Mean | Max | Min | S. D | CV (%) |
|---|---|---|---|---|---|---|---|---|---|
| Water Holding Capacity (WHC) (%) | Male | 200 | 30.6 | 377 | 30.2 | 35.5 | 21.5 | 3.2 | 10.4 |
| | Female | 177 | 29.9 | | | | | | |
| Water Absorption Capacity (WAC) (%) | Male | 174 | 15.5 | 323 | 15.5 | 38.5 | 5.0 | 6.8 | 43.9 |
| | Female | 149 | 15.6 | | | | | | |
| Drip loss (%) | Male | 199 | 11.5 | 377 | 11.7 | 26.0 | 5.0 | 3.3 | 28.2 |
| | Female | 178 | 11.9 | | | | | | |
| Cooking loss (%) | Male | 202 | 26.8 | 380 | 27.3 | 37.0 | 17.5 | 4.9 | 17.8 |
| | Female | 178 | 27.8 | | | | | | |
| pH24 hours | Male | 196 | 4.7 | 367 | 4.7 | 5.3 | 4.3 | 0.6 | 12.0 |
| | Female | 171 | 4.7 | | | | | | |
| pH20 min | Male | 197 | 5.1 | 374 | 5.0 | 5.8 | 4.4 | 0.4 | 6.9 |
| | Female | 177 | 5.0 | | | | | | |
| Temperature 24 hours | Male | 200 | 15.1 | 377 | 15.0 | 22.3 | 5.4 | 4.4 | 29.0 |
| | Female | 177 | 14.8 | | | | | | |
| Temperature 20 min | Male | 193 | 27.0 | 370 | 27.0 | 38.3 | 19.2 | 6.2 | 23.1 |
| | Female | 177 | 27.1 | | | | | | |
| l* | Male | 199 | 37.8 | 373 | 37.9 | 56.0 | 21.0 | 8.5 | 23.3 |
| | Female | 174 | 37.9 | | | | | | |
| a* | Male | 196 | 11.9 | 370 | 12.5 | 23.0 | 4.0 | 3.9 | 30.9 |
| | Female | 174 | 13.1 | | | | | | |
| b* | Male | 203 | 12.8 | 384 | 13.6 | 21.0 | 7.0 | 2.6 | 19.1 |
| | Female | 181 | 14.5 | | | | | | |
| C* | Male | 196 | 7.0 | 370 | 7.2 | 9.3 | 4.7 | 0.7 | 9.7 |
| | Female | 174 | 7.4 | | | | | | |

lower WHC (Ribarski and Genchev, 2013). Low meat pH values reduce the WHC and tenderness of meat and increase the cooking loss percentage. According to most investigators, meat pH is not sufficient to characterize meat quality, since meat technological properties are mostly dependent on colour characteristics of breast meat, its structure and water holding capacity (Genchev *et al*., 2010).

An investigation of physicochemical properties of poultry meat demonstrated that pH of chicken meat is very low, hence it's WHC. This increased the drip loss during storage and the cooking loss (Ribarski and Genchev, 2013). Since a low pH is associated with a decrease in water holding capacity and a pale colour, and a high pH with a poor storage quality, it is concluded that ultimate pH can modify the technological properties of the meat (Le Bihan-Duval *et al*., 2003).

It is reported that, meat pH in Manchurian Golden Japanese quails from the time of slaughter to rigor mortis resolution, decreased from 6.13±0.04 to 5.91±0.03 in breast meat (Genchev *et al*., 2010). Also reported that, while higher muscle pH is associated with darker meat, the lower muscle pH values are associated with lighter meat; thus muscle pH and the meat colour are correlated. pH in a normal poultry muscle can reach 7.2, after death, however, due to the muscle acidifying, the value drops to 6.0 or less through the lactic acid build -up. pH, furthermore, plays a significant part during emulsification and is strictly related to the functional and physiochemical properties of emulsion (Boni *et al.,* 2010). An analysis on physicochemical properties of goose meat revealed that during the first 45 min following slaughter, pH dropped by 1.1 and 7.1%, whereas after 24 hours, the decrease was by 9.7-19.3%. A similar dynamics of pH drop was proven to be 7.5-11% on average in Japanese quail meat (Ribarski and Genchev, 2013).

In Pharaoh quails, however, the meat pH of a 35-day-old quail oscilates between 5.95 and 6.18 depending on the slaughter age; the pH1 of the breast muscle ranges between 5.92 and 5.98 (Ribarski and Genchev, 2013). A comparative analysis on pH of turkeys, partridges, chickens, and Japanese quail meat reported the highest pH values in Japanese quail – both prior to rigor mortis (6.58) and after that (6.38). It can be deduced that, therefore, the glycolysis occurred in the muscles of Japanese quail at a slower rate compared to other poultries, particularly broiler chickens and turkeys (Ribarski and Genchev, 2013). Although in freshly slaughtered birds the meat pH is closer to the neutral, it drops to 6.02-6.41 in rigor mortis. The breast meat pH was recorded to oscillate between 6.2-6.3 twenty minutes post mortem (pH at 20) (Genchev *et al*., 2010). It was also reported that immediately after slaughtering, meat pH in breast muscle oscillated between 6.06-6.21. From the time of slaughter to rigor mortis resolution, the breast meat pH values dropped from 6.13±0.04 to 5.91±0.03 (Genchev *et al*. 2010).

**Table 2. Mean (High and Low Breeding Value) of meat quantity and quality traits.**

| Trait | Mean (Low Breeding Value) | Mean (High Breeding Value) |
|---|---|---|
| Body weight (gr) | 177.38 | 315.14 |
| Carcass weight (gr) | 129.34 | 242.36 |
| Breast weight (gr) | 55.16 | 61.75 |
| Thigh weight (gr) | 24.20 | 41.72 |
| Water Holding Capacity (WHC) (%) | 31 | 29.6 |
| Water Absorption Capacity (WAC) (%) | 22.8 | 24.5 |
| pH1 | 5.07 | 5.14 |
| pH2 | 4.81 | 4.86 |
| Temperatur1 (°c) | 23.52 | 28.64 |
| Temprature2 (°c) | 18.16 | 14.6 |
| Cooking loss (%) | 26.5 | 26.5 |
| Drip loss (%) | 12.2 | 9.8 |
| a* | 11.4 | 12 |
| L* | 37.6 | 39.25 |
| b* | 13.6 | 12.75 |

**Colour**

After slaughtering (30 min), meat colour of all samples were measured and ranged between 21-56 with an average of 37.9 for L*; 4-23 with an average of 12.5 for a*; 7-21 with an average of 13.6 for b* and 4.7-9.3 with an average of 7.2 for c* of pectoral muscles (Table 1). Colour values of studied muscles of breeding values are listed in Table 2. There were no statistically significant differences between high and low groups of quails about a* but there were significant differences between L* and b*.

Due to their influence on the consumers' initial selection and ultimate product satisfaction, appearance, texture and colour are among the most significant poultry meat characteristics (Narinc *et al*. 2013). The colour of meat is an organoleptic trait which could be directly evaluated and indicating the topographic area, species, freshness and tenderness of the produced meat. Meat colour depended on the amount of heme pigments, and mostly on the chromoprotein myoglobin (Mb) and the post mortem chemical alterations it suffered. The colour traits are also dependent on the amount, the colour and distribution of intramuscular fat, as well as on structural and ultrastructural changes in myofibrillar proteins by the time of rigor mortis. Numerous factors influence the colour of raw chicken meat – breed, sex, age, feeding, pre slaughter preparation, stunning, slaughter, scalding temperature, method and regimen of cold storage, storage terms etc. (Ribarski and Genchev, 2013).

It was reported that, the average L* values in males were 44.98±0.42 and in females 44.75±0.30, the overall range was between 40.6 and 56.1 Only in birds slaughtered at 31 days of age, the difference between genders was 5.6% and statistically significant ($P<0.01$). The coordinates in the red/green spectrum (a*) varied from 5.1 to 14.4 (average for all samples 10.46±0.15). The coordinates in the yellow/blue spectrum (b*) ranged between 7.9 and 13.4 (10.8±0.12 on the average). Similarly to a*, the gender-related differences in b* were insignificant (10.93±0.18 in males and 10.68±0.16 in females). Breast meat redness and yellowness accounted for the excellent chroma of the meat of the studied Japanese quail breed (15.09±0.15). The average C* values in males were 15.15±0.22, with a tendency towards increased chroma of meat from 14.6±0.4 to 16.2±0.4 ($P<0.05$). The average C* values of breast meat in female quails were 15.03±0.22 and age-related changes were not demonstrated. This relative stability in females, together with the increasing chroma of the meat of males caused the statistically significant 8.5% difference between both genders at the age of 42 days ($P<0.05$) (Genchev *et al*. 2010).

Many investigations have reported increase in L* values during the first 24 hours followed by inconsistent changes thereafter. Literature reports indicated values between 33.7-35.4 and 53.7–57. The lightness of breast muscles differed among domestic fowl species: between 38.2-39.2 in goose and 42.6-45.3 in ducks (Ribarski and Genchev, 2013).

The redness or a* values depend primarily on myoglobin content of muscle fibers. It is the main pigment responsible for the colour of the fresh meat. With regard to the currently prevailing myoglobin form (oxygenated – MbO2, reduced– Mb or oxidized– MMb), meat colour could substantially differ among various assessments. This is supported by the rather broad range of published a* values. In available literature on colour traits of Japanese quail breast meat, a* values could be roughly divided as low – 9.7, medium – 11.7-12.5 and high – 13.1-16 (Ribarski and Genchev, 2013).

The values of the b* colour coordinates are influenced by multiple pigments which could enhance or attenuate the colour in the yellow-blue spectrum. Biliary pigments, derivatives of heme, are among the most commonly encountered in the animal organism. Biliverdin for instance, is yellow-coloured. Another group of yellow pigments are carotenoids and flavoproteins, which depends on their form could present one colour or another. The published yellowness values vary from 9.29–9.79 and 17.1-18.0. According to some authors, b* values are mainly influenced by the composition of fattening ration. Statistically significant higher b* values of both breast muscles were reported after dietary supplementation of antioxidants to Japanese quails. Chroma values are a main indicator of the amount of myoglobin in muscles and thus, C* values determined the saturation of their colour (Ribarski and Genchev, 2013). Also researchers reported that, Breast meat L* values of Manchurian Golden Japanese quails varied between 40.6 and 56.1. The coordinates in the red/green spectrum (a*) varied from 5.1 to 14.4, and in the yellow/ blue spectrum (b*) from 7.9 to 13.4. Breast meat redness and yellowness accounted for the excellent chroma of the meat of the studied Japanese quail breed (15.09±0.15) (Genchev *et al*., 2010).

**Water Holding Capacity (WHC) and Water Absorption Capacity (WAC)**

After slaughtering, WHC and WAC of pectoral muscles were measured and ranged between 21.5-35.5 with an average of 30.2, and 5-38.5 with an average of 15.5 respectively (Table 1). The values of studied muscles of the breeding values were listed in Table 2.

The quality of raw meat in terms of storage and processing depended on its hydrophilic properties – Water Holding Capacity (WHC) and Water Absorption Capacity (WAC). Muscle tissue contained about 75% water but only 10- 15% of it was chemically bound to proteins. The other amount was retained by the spatial structure of proteins as “free water”. Therefore, WHC is the highest immediately after slaughtering, prior to rigor mortis occurrence. After rigor mortis resolution, the WHC of meat was reduced. The good water holding capacity of breast and leg meat guarant excellent technological properties of meat. The lower WHC of the pectoral muscle in female quails could be related to slightly lower breast meat pH values. Poultry meats with lower pH are characterized with lower water holding capacity (Genchev *et al*., 2010).

It was reported that, the Water Holding Capacity (WHC) of meat varied within 18.05 and 21.7% (Genchev *et al*., 2010). The WHC of pectoral muscle and biceps femoris muscle ranged between 18.05-21.7%. The average water loss from the pectoral muscle after pressing force application (WHC) was 19.32±0.46 % in males and 20.64±0.52 % in females (Genchev *et al*. ,2010). Also reported that the WAC of meat in isotonic physiological saline varied between 24 to 29.6% for the pectoral muscle (26.36±0.69 %) (Genchev *et al*., 2010).

**Drip loss**

After slaughtering drip loss, pectoral muscles were measured and ranged between 26-5 with an average of 11.7 (Table 1). The values of the studied muscles of breeding values were listed in Table 2.

Drip loss percentages of meat varied from 1.07 and 0.6% of carcass weight, with a weak tendency for reduction of values in both sexes with slighter age advancing. For according to numerous investigators, lighter meats tended to exhibit higher drip losses (Genchev *et al*., 2010).

**Cooking loss**

After slaughtering, cooking loss of pectoral muscles were measured and ranged between 17.5-37.0 with an average of 27.3 (Table 1). The values of studied muscles of breeding value are listed in Table 2.

Meat tenderness is a complex parameter depending on numerous factors, including the proportion of tissue that builds up the muscle. The higher tenderness of the pectoral muscle in female quails could be attributed to the slightly higher percentage of dark muscle fibers, whose diameter is smaller than that of light ones, as well as to the higher content of connective and especially intramuscular fat tissue. The higher proportion of muscle tissue in the pectoral muscle of male quails could partly account for the higher cooking losses of breast meat. It was acknowledged that only 10-15% of muscle water was chemically bound to proteins. The other amount (about 60- 65%) were "free water", that gets lost during cooking as a result of protein denaturation (Genchev *et al*. 2010).

It was reported that the average cooking loss percentage was 28.81±0.76 for breast meat. In general, the values recorded in male birds were higher compared to those in females 31.20±1.09 vs 26.42±0.79 (P<0.001) for breast meat. The sex related difference was more pronounced after the age of 35 days, when it attained 18.3-31% (Genchev *et al*. 2010).

**CONCLUSION**

In this study, the results of the quantitative and qualitative characteristics of the 368 birds found that the average of water holding and absorption capacity, drip loss and primary pH were lower than the reported values. But average values of L * and b * were higher. Thus it can be concluded that selection for increased productive for weight gain at 42 days of age may be a reason to decrease the water holding capacity and to increase the colour characteristics.

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