



CARCASS YIELD AND PHYSICO-CHEMICAL CHARACTERISTICS OF JAPANESE QUAIL MEAT

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ABSTRACT

The use of poultry meat and its products has grown throughout the world. Over the last few years, quail (*C. coturnix*) meat has attained much attractiveness among consumers. During present study twenty (n=20) Japanese quails were purchased and carcass yield and physico-chemical characteristics of meat were determined. Carcass yield, physico-chemical characteristics such as pH, water holding capacity, drip loss, cooking loss, protein, fat, ash, glycogen and calorific value were determined according to the established methods. The results revealed that the average carcass yield in group A (69.52±0.42%) was statistically lower ($P < 0.05$) to that of group B (72.16±0.73%) whereas the pH values in both groups were non-significant (group A, 6.44±0.06%; group B, 6.52±0.04%). The difference in water holding capacity and cooking loss of quail meat in two groups was found non-significant ($P > 0.05$). Average drip loss in quail meat of group A (2.64±0.26%) was remarkably higher than that of group B (2.62±0.25%). The protein content of quail meat in group B (21.21±0.58%) was significantly ($P > 0.05$) higher than group A (19.40±0.49%). The fat content in group B (3.53±0.21%) was significantly higher ($P < 0.05$) than that of group A (2.83±0.22%). Moreover, the glycogen content in group A (1.74±0.87%) and group B (1.38±0.11%) was also significantly different ($P < 0.05$). The ash content of group A (1.00±0.67%) and group B (1.03±0.98%) was non-significant ($P > 0.05$) to each other. Less calorific values were obtained from meat of Group A (109.07±3.03k.cal) compared to group B (123.94±2.87 k.cal). In conclusion, the quails less than 45 days age have low dressing %, less macronutrients, thus producing meat with less calorific contents.

Keywords: dressing percentage, physico-chemical characteristics, quails meat

INTRODUCTION

Quails are small-to-medium sized birds, belonging to the same biological family of chicken and pheasants (*Phasianidae*). The adult weight of quail is about 300g, attains sexual maturity at 42-48 days of age, produce up to 290 eggs/ year with egg weight ranges from 9-10 g (Boni *et al.*, 2010; Akinwumi *et al.*, 2013; Daikwo

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et al., 2013). A number of breeds and varieties of quails have been developed for production purpose. The largest number of quail birds has been found in South-East Asia. The prevailing breeds in Europe and USA are those of the combined egg and the meat production type. The percentage content of edible meat in Japanese quail is very high. Quails consume relatively less feed and require less space (Banerjee *et al.*, 2010).

The use of poultry meat and its products has grown in whole world. Over the last few years, quail (*C. coturnix*) meat has received much attractiveness among consumers. Quail meat is being used as an alternate potential and acceptable meat source. In many parts of the world quail meat is regarded as a desirable food and its consumption is increasing in almost all the countries as a best source of protein. The quail meat may be considered as a competitive source against the broiler meat. According to some studies, it is believed that quail meat quality is nearly same or even better than chicken meat (Ayyub *et al.*, 2014). With the increase in egg and meat production, attempts at assortment diversification have been made. These trends are particularly visible in meat production. Ostrich, pheasant or quail meat is more often available in big retail stores. The quail production is not an established branch, but nevertheless, plays a vital role in poultry meat production (Genchev *et al.*, 2008).

The largest quail meat producer is Europe, followed by USA. So far as quail meat consumption is concerned among European countries, the maximum quail meat consumption has been recorded in France, Italy and Spain. It is very important to study the properties of quail meat in order to determine the growing interest of consumers. Physico-chemical properties of quail meat are influenced by many factors such as feeding and slaughtering age (Genchev *et al.*, 2008).

In freshly slaughtered birds, meat pH is near to the neutral but when rigor mortis occurs; it decreases up to 6.02. The quality of raw meat in terms of storage and processing depends on its hydrophilic properties—water holding capacity and water absorption capacity. Although quail muscle tissue contains about 75% water, only 10- 15% of it is chemically bound to proteins, while the rest is free water (Genchev *et al.*, 2010). During the last few years, the global use of poultry meat has increased. Along with increased chicken and turkey meat production, there is also a growing interest towards the consumption of meat from Japanese quails, pheasant and other non-commercial birds. Now a day, many countries in Asia, Europe and America are rearing Japanese quails for eggs and meat production. Quails meat had the lowest-calories with high protein content (Ribarski *et al.*, 2013). Looking at the growing trend of consumers towards the Japanese quail meat and scarce knowledge available on physico-chemical properties and dressing percentage of quail meat, the present study was designed.

MATERIALS AND METHODS

A total of twenty (n=20) Japanese quails were purchased from Karachi bird market, divided and kept into two cages labeled as Group-A and Group-B and brought to the Department of Animal Products Technology, Faculty of Animal Husbandry and Veterinary Sciences, Sindh Agriculture University Tandojam. The birds less than 45 days were grouped as Group-A (young) and birds more than 45 days were grouped as Group-B (adult). In First-phase, live body weight of

birds was taken on electronic digital weighing balance and thereafter quails were slaughtered through Halal method.

Carcass yield: In second phase the dressing percentage of quail was calculated using following formula:

$$\text{Dressing (\%)} = \frac{\text{Carcass weight of quail}}{\text{Live weight of quail}} \times 100$$

In third phase, the samples were analyzed for macronutrients i.e. protein, fat, glycogen and total minerals, physical characteristics viz. pH value, cooking loss, water holding capacity and drip loss. Finally, calorific value of meat was calculated on the basis of macronutrients analysis.

Physical analysis

Water holding capacity, pH value, cooking loss and drip loss were determined using protocols reported by Wardlaw *et al.* (1973); Ockerman (1985); Kondaiah *et al.* (1985) and Sen *et al.* (2004), respectively.

Chemical analysis

Protein (Kjeldhal), fat (Ether extraction) and ash contents of quail meat were determined according to the methods described by Association of Official Analytical Chemists (AOAC, 2000). Furthermore, glycogen content of meat samples was determined by spectrophotometric method (Kemp *et al.*, 1953). Finally, calorific values of the meat samples were calculated from major components by using conversion factors like 4 for protein and/or carbohydrates and 9 for fat as reported by Johnson *et al.* (1995).

Statistical analysis

The data was subjected to statistical tool i.e. analysis of variance (ANOVA) at 95% confidence level and alpha level set as $P \geq 0.05$. The statistical analysis was performed using statistical software, Student Edition of Statistic (SXW) (copyright 2005, Analytical Software, USA).

RESULTS

Dressing percentage in two age groups of quail meat was analyzed and found that dressing percentage of group A ranged between 67.30 to 72.00% and in group B it was varied between 68.42 to 75.73%. It was further observed that average dressing percentage of group B (72.16 ± 0.73) found higher compared to that of group A (69.52 ± 0.42). Coefficient of variation (CV) was found higher (3.23%) in group B while group A showed CV as 1.92%.

The pH value of quail meat in two different age groups was analyzed (Figure 1) and it was observed that pH value varied in two groups; 6.20 to 6.74 (group A) and 6.37 to 6.72 (group B). The pH was found to be higher in group B (6.52 ± 0.04) as compared to that of group A (6.44 ± 0.06), however the results were statistically non-significant ($P > 0.05$). Quail meat of two different age groups was analyzed for water holding capacity (Figure 1) and result showed a wide

variation within the same group of quail meat. Water holding capacity of quail meat of groups ranged between 70.00 to 78.33 % in group A, 71.86 to 81.66 % in group B. Results further showed the water holding capacity of quail meat in group A and B was $74.71 \pm 0.72\%$ and $76.23 \pm 0.86\%$, respectively. Coefficient of variation (CV) was found to be higher in group B (3.58%), followed by group A (3.05%). Analysis of variance revealed that group A and group B were non-significant ($P > 0.05$) to each other.

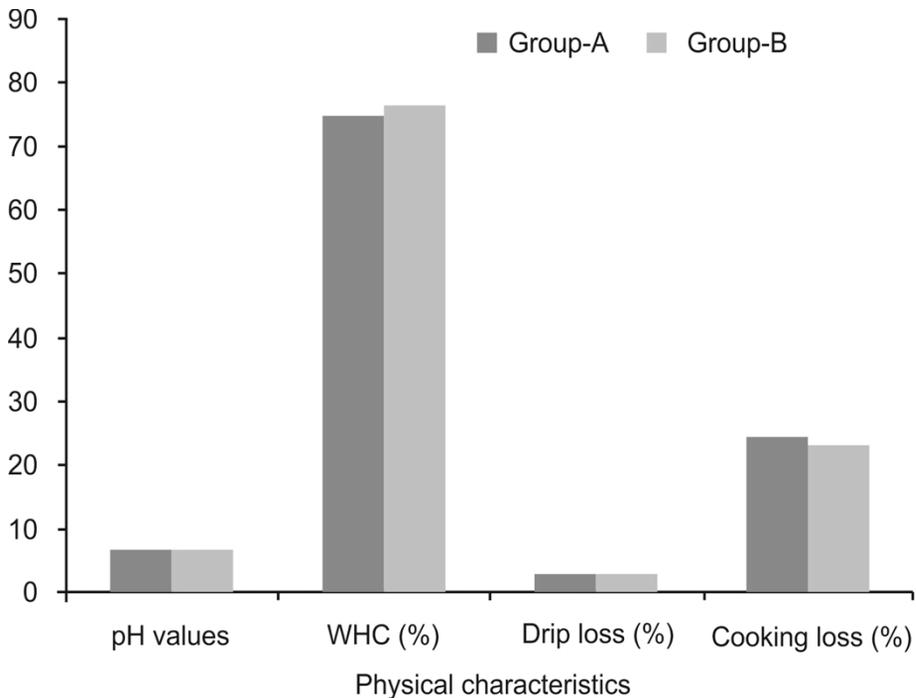
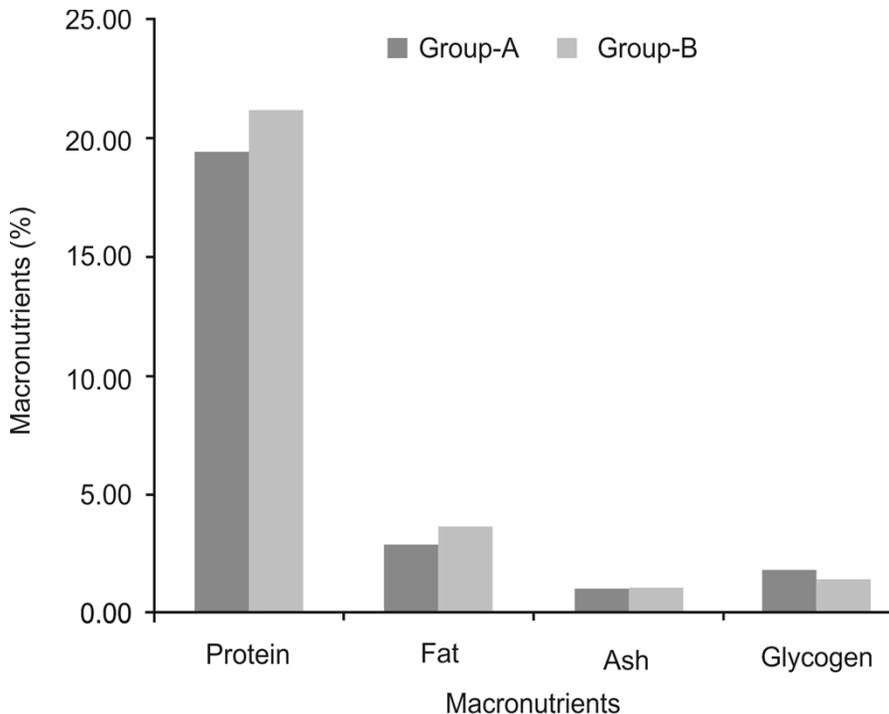


Figure 1. Physical characteristics (macronutrients) of quail meat of two age groups

The drip loss in quail meat of two age groups was analyzed and it was found that drip loss of meat of group A ranged between 1.88 to 3.98%, while in group B it was 1.84 to 3.98%. It was further observed that drip loss was higher in meat of group A (2.64 ± 0.26) compared to meat of group B (2.62 ± 0.25) (Figure 1). Coefficient of variation (CV) was higher (31.35%) in group A while group B showed CV as 31.20%. Statistically, the difference in drip loss between two groups was non-significant.

Cooking loss in quail meat of group A varied between 19.95 to 29.80% and that in group B ranged between 19.90 to 27.60%. Cooking loss in meat of group A (24.38 ± 1.08) was slightly higher in contrast to meat of group B (22.93 ± 0.86) (Figure 1). It was computed that cooking loss between group A and B shows non-significant difference. The results of protein content in quail meat of two age groups showed variation in group A (17.18 to 21.87%) and B (18.81 to 24.06%).

The average protein content of quail meat in group A ($19.40 \pm 0.49\%$) was significantly different from ($P < 0.05$) group B ($21.21 \pm 0.58\%$) (Figure 2). Coefficient of variation (CV) was found higher in group B (8.57%) than that of group A (8.15%). The results of fat content in quail meat of two age groups showed wide variation (group A, 1.5 to 3.6% and B, 2.4 to 4.70%) in both groups of quail meat. Coefficient of variation (CV) was found to be higher (24.51%) in group A while group B showed 19.31%. Furthermore, it was concluded that fat content in group B ($3.53 \pm 0.21\%$) was significantly higher ($P < 0.05$) than group A ($2.83 \pm 0.22\%$) (Figure 2). Glycogen content in quail meat of two age groups was examined and results depicted that glycogen content varied between two age groups of quail meat; group A (1.28 to 2.16%) and group B (0.93 to 1.90%). Coefficient of variation was found higher in group B (26.25%) than group A (15.91%). Further it was observed that the glycogen percentage in group A ($1.74 \pm 0.87\%$) was significantly higher than that of group B ($1.38 \pm 0.11\%$) (Figure 2).



Group-A = Quail meat of <45 days age group Group-B = Quail meat of >45 days age group

Figure 2. Chemical characteristics (macronutrients) of quail meat of two age groups

Ash content of quail meat in two age groups was analyzed and results were found variable between 0.80 to 1.20% in meat of group A and 0.60 to 1.40% in

meat of group B. Coefficient of variation was found higher (30.14%) in group B while group A showed 21.18% CV. Results were non-significant ($P > 0.05$) as no any significant difference was ascertained among two groups (Figure 2).

A wide variation in calorific value of same age groups of quail meat was observed between 99.90 to 124.08 kcal/100g and in group B 106.20 to 138.14 kcal/100g. The CV was recorded higher in group A (8.79%) and lower in group B (7.32%). However, the average calorific value of group A quail meat was significantly lower ($P < 0.05$) (109.07 ± 3.03 kcal/100 g) than that of group B (123.94 ± 2.87 kcal/100 g).

DISCUSSION

The human health mainly depends on the safety and quality of food and nutritional status. Health status of people particularly in under-developed countries is not satisfying which is associated with utilization of poor quality food such as meat (Brown *et al.*, 2000). Physico-chemical characteristics of meat are known to closely correlate with its nutritional and commercial value (Li and Zan, 2011). There are many factors which are responsible for the stability of physico-chemical and nutritional qualities of the meat. Among these, slaughtering age is one of the predominant factors which greatly influence the quantity and quality of the final product (Geay *et al.*, 2001).

Dressing percentage of quail meat was found to be higher in spent quails (72.16%) as compared to young quails (69.52%). These results are in accordance with those of Seker *et al.* (2007) who found that older quails have higher dressing percentage. Wilkanowska *et al.* (2011) supported the present results, i.e they reported that the older quails have high dressing percentage than that of young quails. Old quails contained more leg muscles, large proportion of breast muscle with higher neck compared to young quails. In addition, older quails had a greater proportion of skin with subcutaneous fat.

It is of interest to note that after slaughter of animal, there could be the cessation of oxygen supply to muscle cell due to failure of blood circulatory system (Warriss, 2000). As a consequences, aerobic glycolysis is no longer possible and anaerobic glycolysis take over (Romans *et al.*, 2001), resulting in accumulation of lactic acid in muscle (Aberle *et al.*, 2001) which in turn may decline pH value of meat. The pH value of quail meat of adult was slightly higher (6.52) than that of young ones (6.44) but statistically non-significant ($P > 0.05$). The results are in accordance with the finding of Kuźniacka *et al.* (2007) and Ikhlas *et al.* (2011) who reported that spent quail meat have higher pH as compared to young quail meat. It is of interest to note that after slaughter of animal, there could be the cessation of oxygen supply to muscle cell due to failure of blood circulatory system (Warriss, 2000). As a consequences, aerobic glycolysis is no longer possible and anaerobic glycolysis take over (Romans *et al.*, 2001), resulting in accumulation of lactic acid in muscle (Aberle *et al.*, 2001; Henike, 2004) which in turn may decline pH value of meat.

Water holding capacity in group A was lower (74.71 ± 0.72), compared to group B and showed non-significant differences between age groups. High muscle pH will results in high water holding capacity, because at high pH the negative charge of my filaments creates a strong repulsive electrostatic forces within the filaments which pushes the filament apart, swells up the lactic acid and

hence increases the space where the water is lodged. The relationship between pH and water holding capacity is well established (Warriss *et al.*, 1999). An increase in water holding capacity with an increase in slaughter age of quails has been reported by Wilkanowska *et al.* (2011). The drip loss in quail meat of group A was $2.64 \pm 0.26\%$ that is remarkably higher as compared to the drip loss in quail meat of group B. Drip is a dilute solution exude/purge of sarcoplasmic protein attributed with denaturation of muscle protein due to fall in pH (Warriss, 2000), sarcomere shortening (Honekel *et al.*, 1986) and myosin degeneration (Offer, 1991), resulting shrinkage of myofibrillar component which in turn expels the resultant fluid into extracellular space (Warriss, 2000). Gracey *et al.* (1999) and Hui *et al.* (2001) supported the result of present study.

It was observed that the cooking loss of quail meat of group A (24.38 ± 1.08) was statistically higher than that of group B (22.93 ± 0.86). It could be argued that cooking loss in meat is assumed to be a loss of water that muscle originally contained and could be attributed with denaturing/coagulation of myofibrillar and sarcoplasmic protein. At cooking temperature 65°C , the cooking loss was reported to be about 30% and at 80°C over 40% (Warriss, 2000). Moreover, the fall in pH value could result in poor water capacity of myofibrillar muscle protein and in incline condition of pH, the vice versa. Muscle with low water holding capacity appeared to be with higher drip and cooking losses and inverse in case of high WHC (Bruce *et al.*, 2003).

Protein content of quail meat increased with the advanced slaughtering age. It was concluded that protein of quail meat of group B was higher ($P < 0.05$) than that of protein of group A. The results of present study agreed with the findings of Kandeepan *et al.* (2009); Awan (2010); Ikhlas *et al.* (2011) and Qiang *et al.* (2011) who found higher protein content in old age quails as compared to young quails. Muscle growth, or protein accretion, occurs when protein synthesis exceeds protein degradation. The significant protein accretion occurs probably due to hyperplasia, hypertrophy and a decrease in protein degradation while the protein synthesis levels remain the same (Koochmaraie *et al.*, 2002).

Average fat content of young age quail meat was comparatively low (2.83%) than the average fat content of old age quails (3.53%). These findings are in line with the results of Madruga *et al.* (1999); Stankov *et al.* (2002); Genchev *et al.* (2008); Boni *et al.* (2010); Ikhlas *et al.* (2011) who found that old age quails have more fat content than their young ones. It has been well studied that as animal get older and heavier the proportion of fat in their carcasses increases and proportion of muscle and bone decreases (Warriss *et al.*, 2000).

The average ash content of quail meat of group B was non-significantly higher ($P > 0.05$) than that of group A. The results of present study agreed with the finding of Madruga *et al.* (2006) who found that age had substantial effect on physico-chemical characteristic of meat. Pieniak-Lendzion *et al.* (2008) also found that increase in slaughtering age results with increase in ash content. In fact the increase in ash content in advancing in turn age could be attributed with postnatal growth under which cell number and cell size increases during the growth of muscle (Koochmaraie *et al.*, 2002). This probably occur via fusion of satellite cells and contribute nuclei to muscle fiber, which in turn leads to increase in both muscle mass and mineral content at advancing age (Hawk and Garry, 2001).

The average glycogen level was found statistically higher in group A compared to that of group B. Ikhlas *et al.* (2011) supported the present result; they reported that the spent quails have lower reserve of glycogen than that of younger. Many pre-slaughter and post-slaughtering factors influence the glycogen contents of meat. Among them stress is the most important pre-slaughter factors (Grandin and Gallo, 2007). Long term stress depletes the muscle glycogen storage after slaughter which leads to low acid production thus pH becomes high. The increased pH improves the space availability therefore more water remains retained within myofibrillar proteins (Bruce *et al.*, 2003). The calorific value in group B was significantly higher ($P < 0.05$) (106.20-138.14 kcal) than group A (99.90-124.08 kcal). Present study agreed with that of Mojto *et al.* (2009) who found that older animals have higher calorific values as compared to young animals. The present study was also agreed with the study of Brzostowski *et al.* (2008) who found that due to a high protein content (19.44 and 19.74 %); low levels of intramuscular fat (1.67 and 1.96 %) and cholesterol (48.76 and 56.63 mg/100g), a low energy value (96.36 and 101.47) in 50 days old kid were observed.

CONCLUSION

In conclusion, the dressing percentage was high in adult quails (>45 days age). However, no any significant difference was noted in water holding capacity of young and adult quails. The cooking loss and drip loss was decreased with the increase of age. Quail meat of >45 days age was rich in macro-nutrients like protein, fat and total mineral content. The glycogen content was high in young quail meat whereas more calorific meat was obtained from adult birds.

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