

## Comparison of meat quality characteristics between young and spent quails

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**Abstract:** The aim of this study was to determine the meat quality characteristics of young and spent quail meats. Young quail meat (age 8 week  $\pm$  3 days) and spent quail meat (age 8 month  $\pm$  3 days) were used in this experiment. Comparison of the proximate compositions, pH, colour, and fatty acid of quail meats showed significant differences ( $p < 0.05$ ). The young quail meat had significantly higher moisture, protein, and ash content than the spent quail meat ( $p < 0.05$ ), while it showed significantly lower fat content compared to spent quail meat ( $p < 0.05$ ). The pH of spent quail (6.62) was higher than young quail (6.53). Colour parameters for young and spent quail meats were,  $L^* = 58.93$ ,  $a^* = 12.86$ ,  $b^* = 20.86$  and  $L^* = 61.54$ ,  $a^* = 6.84$ ,  $b^* = 19.81$ , respectively. Fatty acid composition of the spent quail meat did not suggest any large variations compared with young quail meat. The major fatty acids of both quail meat were oleic acid (C-18:1n9), linoleic acid (C-18:2n6), palmitic acid (C-16:0) and stearic acid (C-18:0). This study showed the differentiation in proximate, colour, pH and fatty acid composition with occur between young and spent quails.

**Keywords:** Quail meat, age, meat characteristic, fatty acid composition

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### Introduction

In recent years quail meat has been gaining much popularity among consumers. Generally, quails are small-to-medium sized birds, belonging to the same biological family of chicken and pheasants (*Phasianidae*), given the overall similarity in physical characteristics and behaviour. Quails, most commonly bred for human consumption, belong to the species *Coturnix coturnix japonica*. Their distribution in the wild spreads over large areas of Asia, Europe and Africa, but they were first domesticated in Japan (Mizutani, 2003). According to Mizutani (2003), they were initially kept for their singing abilities. It was for this reason that they were seen more as pets. Only in the beginning of the 20<sup>th</sup> century did commercial production begin in Japan. From there it spread first to China and soon after to Europe. Quail meat has been known for centuries, and there are even biblical quotations of their use as a meat source.

Characteristics of quails are that adult weighs to 300 g, sexual maturity is 42-48 days, egg production is up to 290/year with weight between 9-10 g, life span of between 3-4 years and a carcass yield of

around 75-78% (Mizutani, 2003). Broiler quails are slaughtered at about six weeks of age (Shanaway, 1994). The old breeding birds (8 weeks) are also slaughtered and sold on the commercial market without any distinction being made on age (Shanaway, 1994). This has led to a number of incidences where wholesalers and retailers have had problem with meat quality specifically, since the meat derived from the older birds appear darker and is apparently tougher upon consumption after cooking. Consumption of poultry meat and poultry meat products is growing all over the world (Mielnik *et al.*, 2002).

Increased production of cut-up and processed meat has provided considerable quantities of parts suitable for mechanical deboning. This process is an efficient method of harvesting meat from parts left after hand deboning meat (HDM) as well as from poor quality poultry. Yields of mechanically deboned poultry meat (MDPM) range from 55 to 80% depending on the part deboned and deboner settings (Mielnik *et al.*, 2002). MDPM is frequently used in the formulation of comminuted meat products due to its fine consistency and relatively low cost.

The use of MDPM in frankfurters, kamaboko-like products, nuggets, sausages, restructured chicken products and mechanically deboned chicken meat is largely used in meat products has been well documented (Babji *et al.*, 1998; Daros *et al.*, 2004; Negrão *et al.*, 2005; Perlo *et al.*, 2006; Lin and Chen, 2008; Froning *et al.*, 2008). Other studies have shown that the quality of further processed products containing MDPM is affected by the particular carcass part used (Pizzocaro *et al.*, 1998). Many differences have been documented for various types of mechanically deboned meat such as colour stability (Demos and Mandigo, 1996), mineral, vitamin and cholesterol content (Al-Najdawi and Abdullah, 2002) and lipid oxidation (Mielnik, 2002). Comparison of bone content in hand deboned meat (HDM) and MDM by Demos and Mandigo (1996) revealed that MDM has a higher ash and Calcium content, signifying greater bone content than HDM (Al-Najdawi and Abdullah, 2002).

Quality is an important attribute affecting consumer reactions to poultry meat. White meat, including quail meat, is considered superior to red meat because it contains low fat content, low cholesterol and, high amount of iron (Jaturashita, 2004). Consumers also acknowledge the relatively low price, the typically convenient portions, and the lack of religious restriction against its consumption (Jaturasitha, 2004). Quail is one of the leanest types of poultry and a good source of protein and minerals such as sodium, potassium and iron. Important PUFA's of meat include the essential fatty acids, linoleic acid (C18:2n - 6) and  $\alpha$ -linolenic acid (C18:3n - 3), as well as the C20 and C22 PUFA's that are present in the phospholipids (Enser *et al.*, 1996). The aim of this study was to determine the meat quality characteristics of young and spent quail meats deboned mechanically on proximate composition, pH, colour characteristics and fatty acid content.

## Materials and Methods

### Raw materials

Two types of quail (young broiler about 8 week and spent about 8 month) use in the experiment. The quail were purchased from the Institute of Poultry Development, Johor Bahru, Malaysia and transported to FIKA Food Sdn. Bhd. Pulau Pinang, Malaysia, where carcasses were deboned mechanically. After deboning all samples were made into 20 kg blocks, and frozen at  $-30^{\circ}\text{C}$  in blast freezer (Irinox, Italy). The blocks were sawn machine (Norwalk, USA) into portions of approximately 1 kg and stored at  $-18^{\circ}\text{C}$  in Freezer (Pensonic, Malaysia) until used.

### Proximate composition

The proximate composition of quail meat was determined according to the AOAC method (2000). The crude protein content was determined by the Kjeldahl method and the crude lipid content was determined by the Soxhlet method. The ash content was determined by ashing the samples overnight at  $550^{\circ}\text{C}$ . Moisture content was determined by drying the samples overnight at  $105^{\circ}\text{C}$ . The carbohydrate content was calculated by difference (total mass of moisture, total fat, ash, and crude protein subtracted from the mass of the food).

### pH

The pH values of samples were determined from a 10 g sample homogenized with 40 ml deionised water. The pH meter used was Mettler Toledo Delta 320 (Shanghai, China).

### Colour

Meat colour was assessed by the  $L^*$  (lightness),  $a^*$  (redness),  $b^*$  (yellowness) system using a Minolta colorimeter (Minolta CM 300m, Osaka, Japan) to determine the colorimetric index of chromaticity.

### Fatty acid composition

The fatty acid composition of quail meat was analyzed by direct transesterification according to Indarti *et al.* (2005). Approximately 2 to 3 g of wet sample was weighed in a bottle. The bottle was covered with aluminium foil and kept in a freezer-dryer (Labconco corporation, Cansas City, Missouri) at  $-20^{\circ}\text{C}$  for 24 h. Two milliliter of methanolic-sulfuric acid (15%) and 2 mL  $\text{CHCl}_3$  (pure chloroform) were added to 0.1 mg of the freeze-dried sample. The sample was then purged by nitrogen gas for 15 s. The tube was closed tightly using a water pipe tape and then shaken on vortex shaker for 2 min. The tube was put in a heating block (Labinco, Netherlands) and heated at  $100^{\circ}\text{C}$  for 30 min. The tube was then allowed to cool down at room temperature in a desiccator. One milliliter of distilled water was added to the sample and shaken on a vortex mixer for 30 s, and then allowed to stand until two layers were formed. The lower layer was taken out and put into an Eppendorf tube. The Eppendorf tube was centrifuged for 5 min at 10,000 rpm (Eppendorf centrifuge 5417R, Germany). The precipitate was removed and a small amount of anhydrous  $\text{Na}_2\text{SO}_4$  was added, and the tube shaken. Finally, the solution was taken out. The fatty acid composition was analysed by GC (Automatic System XL of Perkin Elmer, USA) equipped with a flame ionization detector and a fused silica capillary Omegawax 250 column (30 m $\times$ 0.25

mm ID, 0.25 µm film thickness) from Supelco (USA). Chromatographic data were recorded and integrated in a personal computer (Optiplex GX 110 of Dell) using Turbochrom Navigator TM Software (Perkin Elmer, USA).

#### Statistic analysis

The data from the experiment were analysed as an Independent-Sample T Test using Statistical Package for Social Science (SPSS) software version 15.0 (SPSS Inc., Illinois, USA).

### Results and Discussion

The proximate compositions of quail meat from young and spent quail meat are shown in Table 1. Significant differences ( $p < 0.05$ ) were observed for moisture, protein, fat, ash and carbohydrate contents between both samples. The meat of young quail showed higher protein and moisture contents and lower fat content than spent quail meat. Research on animal meat has indicated that an increase in age is accompanied by an increase in intramuscular fat (Lawrie, 1991). Yang *et al.* (1992); Trindade *et al.* (2004) reported that high proportion of fat and collagen in mechanically deboned meat (MDTM) and subsequent high rate of lipid oxidation. Satterlee *et al.* (1971) found that skin tissues increase the lipid fraction and conversely the protein fraction decreases in mechanically deboned meat samples.

The colour and pH characteristics of quail meat for the different age are presented in Table 2. Young quail meats had significantly higher lightness ( $L^*$ ) values ( $p < 0.05$ ) and lower  $a^*$  ( $p < 0.05$ ) and  $b^*$  values ( $p < 0.05$ ) compared with the spent quail meats. This phenomenon indicates that quail meat, just like beef, chicken, duck and other meats, becomes darker and redder with increasing age, which is mainly due to an increased in concentration of myoglobin pigment (Lawrie, 1991; Berge *et al.*, 1997). For pH values, spent quail meats showed higher pH value ( $p < 0.05$ ) than young quail meat. Richardson and Mead (1999) reported that muscle pH and meat colour are correlated, higher muscle pH is associated with darker meat whereas lower muscle pH values are associated with lighter meat. The pH of a normal muscle (poultry) of is about 7.2, after death the muscle acidifies to values of 6.0 or less through the accumulation of lactic acid (Richardson and Mead, 1999). pH plays an important role during emulsification and is strictly related to the physicochemical and functional properties of an emulsion (Zorba and Kurt, 2006).

The main fatty acids found in the quail meats were palmitic acid (C16:0), oleic acid (C18:1n9)

and linoleic acid (C18:2n9). Oleic acid of young and spent quail meats (34.62%, 33.42%) was the most profic fatty acid, followed by linoleic acid (27.98%, 24.23%), palmitic acid (17.66%, 21.07%) and stearic acid (7.46%, 7.23%), respectively. As with beef, mutton, poultry and ostrich is rich in percentage oleic acid, which was analyzed as the highest percentage of all the individual fatty acids (Cambrero *et al.*, 1991; Sales, 1998; Sales and Horbanczuk, 1998). The percentage of total saturated fatty acid (SFA) and total monounsaturated fatty acid (MUFA) was lowest in young quail. Lawrie (1991) reported that intramuscular lipid composition of most domestic (beef) species change with an increase in age, with an increase in the proportion of saturated fatty acids (SFA) (. The percentage of total polyunsaturated fatty acids (PUFA) and total of unsaturated fatty acid (UFA) was highest in young quail. Higher values for the ratio of total UFA/total SFA were found in young quail meat. Saturated fatty acids are considered to be hypercholesterolemic and the most important ones are lauric (C12:0), myristic (C14:0) and palmitic (C16:0) acid.

### Conclusion

Age of meat had effect on the carcass characteristics of quail meats. Young quail meat had higher moisture content, while mature quail meat had higher protein and fat content. Conversely, redness ( $a^*$ ), yellowness ( $b^*$ ) and pH values were higher for spent quail meat than young quail, while lightness ( $L^*$ ) were lower for spent quail meat as compared to the young quail meat. The main fatty acids found in the quail meats were palmitic acid, oleic acid and linoleic acid. Oleic acid was the highest fatty acid found, followed by linoleic acid, palmitic acid and stearic acid. This study showed the differentiation in proximate, colour, pH and fatty acid composition with occur between young and spent quails.

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Table 1. Proximate composition of young and spent quail meat (wet basis)

Quail Meat	% Moisture	% Protein	% Fat	% Ash	% Carbohydrate
Young	68.98±0.68 <sup>a</sup>	18.99±0.44 <sup>a</sup>	9.21±0.18 <sup>b</sup>	1.52±0.20 <sup>a</sup>	1.30±0.20 <sup>a</sup>
Spent	66.97±0.23 <sup>b</sup>	17.48±0.20 <sup>b</sup>	12.91±0.12 <sup>a</sup>	1.44±0.15 <sup>b</sup>	1.21±0.17 <sup>b</sup>

\* Value is means of 6 replications. Means with the same letter within the same column are significantly different (P<0.05).

Table 2. Colour and pH of young and spent quail meat

Quail Meat	L*	a*	b*	pH
Young	61.54±0.25 <sup>a</sup>	6.84± 0.33 <sup>b</sup>	19.81± 0.32 <sup>b</sup>	6.53±0.03 <sup>b</sup>
Spent	58.93±0.67 <sup>b</sup>	12.36±0.13 <sup>a</sup>	20.86±0.47 <sup>a</sup>	6.62±0.02 <sup>a</sup>

\* Value is means of 6 replications. Means with the same letter within the same column are significantly different (P<0.05).

Table 3. Fatty acid composition of young and spent quail meat

Fatty acid	Young quail meat	Spent quail meat
C14 : 0	0.71 ± 0.05 <sup>b</sup>	0.76 ± 0.14 <sup>a</sup>
C16 : 0	17.66 ± 0.07 <sup>b</sup>	21.07 ± 0.5 <sup>a</sup>
C16 : 1n7	4.88 ± 0.14 <sup>b</sup>	5.06 ± 0.14 <sup>a</sup>
C16 : 2n4	0.17 ± 0.10 <sup>a</sup>	0.15 ± 0.03 <sup>b</sup>
C16 : 3n4	0.10 ± 0.06 <sup>b</sup>	0.11 ± 0.03 <sup>a</sup>
C16 : 4n3	0.14 ± 0.08 <sup>a</sup>	0.09 ± 0.05 <sup>b</sup>
C18 : 0	7.46 ± 0.09 <sup>a</sup>	7.23 ± 0.27 <sup>b</sup>
C18 : 1n9	34.62 ± 0.16 <sup>a</sup>	33.42 ± 1.29 <sup>b</sup>
C18 : 1n7	2.10 ± 0.22 <sup>b</sup>	4.19 ± 3.11 <sup>a</sup>
C18 : 2n6	27.98 ± 0.37 <sup>a</sup>	24.23 ± 0.82 <sup>b</sup>
C18 : 3n6	0.30 ± 0.05 <sup>a</sup>	0.27 ± 0.08 <sup>b</sup>
C18 : 3n4	0.80 ± 0.03 <sup>b</sup>	0.86 ± 0.02 <sup>a</sup>
C20 : 1n9	0.30 ± 0.12 <sup>a</sup>	0.09 ± 0.09 <sup>b</sup>
C20 : 4n6	2.78 ± 0.09 <sup>a</sup>	1.61 ± 1.11 <sup>b</sup>
C20 : 5n3	0 <sup>b</sup>	0.86 ± 1.34 <sup>a</sup>
C20 : 6n3	0.34 ± 0.26 <sup>a</sup>	0.21 ± 0.12 <sup>b</sup>
Total SFA	25.84	29.07
Total MUFA	41.90	42.76
Total PUFA	32.59	28.40
Total UFA	74.49	71.16
Total UFA/Total SFA	2.88	2.45

\* Value is means of 3 replications. Means with the same letter within the same column are significantly different (P<0.05).

\*Fatty acids (% of total fatty acids). SFA, saturated fatty acid; MUFA, monounsaturated fatty acid; PUFA, polyunsaturated fatty acid.

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