

Research Article

Comparison of meat quality characteristics of young and spent quail

Boni Ikhlas*, Nurul Huda and Noryati Ismail

Fish and Meat Processing Laboratory, Food Technology Division School of Industrial Technology, Universiti Sains Malaysia, 11800 Minden, Pulau Pinang, Malaysia.

Email: bonicls@yahoo.com.my

Abstract

Comparison of proximate composition of breast meat derived from 8 week old and 8 month old quails have indicated that an increase in age is accompanied with a significant ($P < 0.05$) reduction in moisture content and a significant ($P < 0.05$) increase in fat content. Amino acid composition and content of the spent quails did not suggest any large variations compared with published results for younger (8 week old) quails. Comparison of colour values of quails have indicated that an increase in age is accompanied with a significant ($P < 0.05$) reduction in reflectance (L^*) and a significant increase in both redness (a^*) ($P < 0.05$) and yellowness (b^*) ($P < 0.05$) values, the meat thus becoming darker and redder with increased age. The pH values of the spent quails were also higher than published results for young quails. The result of measuring 17 types of amino acid composition and content of the spent quails did not suggest any large variations compared with younger birds. This study showed the differentiation in proximate, colour, pH and amino acid composition which occurs between young and spent quails.

Keywords: poultry, meat characteristics, amino acid composition, *Coturnix*, Malaysia.

Introduction

Muscle composition varies with increasing animal age irrespective of sex, breed or species. Research on various species has indicated that an increase in age is accompanied by an increase in intramuscular fat, increased saturation of intramuscular lipids, increased myoglobin concentration and an increase in toughness due to changes in the nature of the connective tissue present in the muscle [1].

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 [2]. Broiler quails are slaughtered at about six weeks of age [3]. The older breeding birds (8 weeks) are also slaughtered and sold on the commercial market without any distinction being made on age [3]. This has led to a number of incidences where wholesalers and retailers have had problems with meat quality specifically, since the meat derived from the older birds appears darker and is apparently tougher upon consumption after cooking. 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, low cholesterol and has a high amount of iron [4].

The composition of amino acids is the factor determining the quality of protein in food. In general, high protein food is also high in the contents of amino acids including essential amino acids [5]. Amino acid data should be reported as mg amino acid/g N or be converted to mg amino acid/g protein by use of the factor 6.25. No other food specific protein factor should be used [6]. It is generally accepted that the nutritional quality of proteins depends on the content and availability of their essential amino acids (EAA) [7]. It is well accepted that the nutritional value of proteins may differ substantially depending on their (essential) amino acid composition and digestibility [8].

The present study was conducted to determine some of these meat quality characteristics on spent (± 8 month old) slaughter birds and to compare the results with published results from similar studies done on younger (± 8 weeks old) quails.

Materials and Methods

Two types of quail (young broilers about 8 week and spent quail about 8 month) were used in the experiment. The quail carcass were purchased from the Institute of Poultry Development, Johor Bahru, Malaysia and transported to the Fish and Meat Processing Laboratory, USM, where carcasses were hand deboned for the meat. Mean carcass weights and age were 200 and 250 g for young and old quail, respectively. The carcasses were wrapped in polythene bags and immediately placed in a freezer (-18 °C). Frozen meat was thawed overnight in a refrigerator (+4 °C) prior to chemical analysis. In this study, only breast meat was used for analysis. Breast meat was separated from the bone and skin and then mixed thoroughly for homogeneity prior to analyses.

Proximate Analysis

The proximate composition of quail meat was determined according to the AOAC methods [9]. 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°C. Moisture content was determined by drying the samples overnight at 105°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).

Colour

Meat colour (illuminant: D65; visual angle: 10; zero and white calibration) was assessed by the L^* (lightness), a^* (redness), b^* (yellowness) system using a Minolta colorimeter (Minolta CM 300m, Osaka, Japan) to determine the colourimetric index of chromaticity. The colour of the fat-free surface was evaluated using the mean value of six colour determinations.

pH

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

Amino acid composition

For analysis preparation, the meat samples underwent freeze drying (Labconco, Missouri, USA) at a temperature of -46°C . Breast meat samples were analyzed in triplicates. Amino acid composition of meat was determined using High Performance Liquid Chromatography (HPLC) method based on Waters Auto TagTM OPA Pre Column Derivatization method.

The test samples were hydrolysed in triplicate with 6N HCl at 110°C for 24 hours and derivatized with AccQ reagent (6-aminoquinolyl-N-hydroxysuccinimidyl carbamate) before carrying out chromatographic separation using an AccQ TagTM reversed phase (3.9 x 150mm) analytical column (Waters®). The amino acid analysis was performed on a HPLC system which consisted of Waters 1525 Binary HPLC Pump, 717 Plus autosampler (Waters®) and Waters 2475 Multi λ Fluorescence detector (wavelength excitation 250nm, emission 395nm). Chromatographic peaks were integrated, identified and quantified with BreezeTM software version 3.20 by comparing it to known standards (Amino acid standard H, Pierce, Rockford, Illinois). Methionine and cystine were determined from the same method of acid hydrolysis after treatment with performic acid oxidation; triptophan was not analyzed in this study.

Statistical 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) [10].

Results and Discussion

The spent quails had significantly lower moisture content ($P<0.05$) and higher fat content ($P<0.05$) compared with the 8 week old birds (Table 1). Research on animal meat has indicated that an increase in age is accompanied by an increase in intramuscular fat [1].

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

Quail Meat	% Moisture	% Protein	% Fat	% Ash	% Carbohydrate
Young	73.01 ^a ±0.38	20.13 ^b ±0.15	3.50 ^b ±0.37	1.35 ^a ±0.11	2.00 ^a ±0.62
Spent	70.28 ^b ±0.38	22.33 ^a ±0.40	4.69 ^a ±0.58	1.26 ^b ±0.06	1.45 ^b ±0.68

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

The colour and pH characteristics of quail meat for the different ages are presented in Table 2. Young quail meat had significantly higher reflectance (L^*) values ($P<0.05$) and lower redness (a^*) ($P<0.05$) and yellowness (b^*) values ($P<0.05$) compared with the spent quail meat. This phenomenon indicates that quail meat, just like beef, chicken, duck and other meat, becomes darker and redder with increasing age, which is mainly due to an increase in concentration of myoglobin pigment [1 and 12]. For pH values, spent quail meat showed higher pH values ($p<0.05$) compared with young quail meat. The 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 [13]. The pH of a normal muscle (poultry) is about 7.2, after death the muscle acidifies to values of 6.0 or less through the accumulation of lactic acid [13]. pH plays an important role during emulsification and is strictly related to the physicochemical and functional properties of an emulsion [14].

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

Quail Meat	L^*	a^*	b^*	pH
Young	48.15 ^a ±0.19	7.30 ^b ±0.16	15.46 ^b ± 0.35	6.13 ^b ±0.03
Old	44.37 ^b ±0.12	9.68 ^a ± 0.18	17.71 ^a ±0.71	6.61 ^a ±0.35

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

The quality of protein in foods determined by the types of it amino acid and the total of its essential amino acid. The quality of protein will be higher if its amino acid type almost similar with the amino acid type of body. The amino acid composition (g/100 g protein) for the different ages quail meat analyses is showed in Table 3.

Table 3. Amino acid composition of young and spent quail meat (g/100 g protein).

Amino acid	Young quails	Spent quails
Alanine	4.70±0.42 ^b	5.04±0.30 ^a
Arginine	10.76±0.66 ^a	8.04±0.25 ^b
Aspartic Acid	6.57±1.09 ^b	6.80±0.71 ^a
Cysteine	0.25±0.09 ^b	1.57±0.08 ^a
Glutamic Acid	12.31±1.36 ^b	12.54±1.37 ^a
Glycine	7.77±1.39 ^a	6.65±1.02 ^b
Histidine	4.07±0.43 ^a	3.93±0.30 ^b
Isoleucine	5.37±0.14 ^b	5.81±0.15 ^a
Leucine	7.44±1.22 ^b	8.66±0.16 ^a
Lysine	7.12±1.27 ^b	7.70±1.07 ^a
Methionine	3.18±0.26 ^a	3.12±0.27 ^b
Phenylalanine	5.48±0.64 ^a	5.25±0.48 ^b
Proline	4.14±0.33 ^a	3.83±0.08 ^b
Serine	4.87±0.31 ^a	4.75±0.21 ^b
Threonine	6.02±1.06 ^a	5.86±0.55 ^b
Tyrosine	2.85±0.35 ^a	2.68±0.19 ^b
Valine	7.12±0.23 ^b	7.77±0.10 ^a

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

Table 3 shows the glutamic acid, arginine and leucine as the highest percentage among 17 amino acid type analyses in both breast of quails. The higher percentage of glutamic acid, arginine and leucine is also found in chicken [15]. It was reported that the muscles of chicken were very high in glutamic acid, arginine and leucine, aspartic acid and lysine, but differences in amino acid compositions were observed between broilers and indigenous chicken muscles.

Amino acid showed similar concentration in all samples and the amino acid profiles do not vary greatly between species [16]. Related noted also reported that the amino acid composition of meat protein remains fairly constant for most species regardless of the type of cut [17]. Glutamic acid was found to have a detectable effect on the taste of chicken meat, which may contribute to the differences in flavour among meat [18]. Similar to the results for camel [19] and beef [20], the amino acid composition of this red meat also shows glutamic acid as the highest in its protein content. These studies found that the glutamic acid of camel and beef are 16.91, and 17.28 g/100 g protein, respectively.

Quail meat, similar to the meat derived from other domesticated species slaughtered for human consumption, shows the typical characteristics of increased darker colour with an increase in age. For these same reasons, beef and mutton are designated veal and lamb, respectively, when the animals are still young, thus indicating to the consumer that a certain colour and tenderness can be expected. Since quail meat is sold as a delicacy in some countries, processors should be aware of these age-induced differences in sensory characteristics and set up an appropriate classification system, which will help to ensure that the consumer is always aware of the type of meat commercially available.

Conclusion

Age of meat had an effect on the carcass characteristics of quail meat. Young quail meat had higher moisture, ash and carbohydrate content, while spent 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^*) was lower for spent quail meat as compared to the young quail meat. The main amino acids found in the quail meat were glutamic acid and arginine. Glutamic acid was the highest amino acid found, followed by arginine. Quail meat has been identified to have higher nutritional value than chicken and the meat is a delicacy to many.

Acknowledgements

The authors acknowledge with gratitude the support given by Universiti Sains Malaysia (USM) and Malaysian Ministry of Science, Technology and Innovation (MOSTI) through the Research Grant Science Fund No. 05-01-05-SF0089.

References

1. Lawrie, R. A. (1991). *Meat Science* (5th Edition). Pergamon Press. Oxford.
2. Mizutani, M. (2003). *The Japanese quail*. Laboratory Animal Research Station, Nippon Institute for Biological Science, Kobuchizawa, Yamanashi, Japan, 408-0041.

3. Shanaway, M.M. (1994). Quail Production Systems. A review. FAO, Rome.
4. Jaturasitha, S., Thirawong, P., Leangwunta, V and Kreuzer, M. (2004). Reducing toughness of beef from *Bos indicus* draught steers by injection of calcium chloride: Effect of concentration and time postmortem. *Meat Science*, 68 (1), 61-69.
5. Kim, B.H., Lee, H.S., Jang, Y.A., Lee, J.Y., Cho, Y.J. and Kim, C. (2009). Development of amino acid composition database for Korean foods. *Journal of Food Composition and Analysis*, 22, 44-45.
6. Eggum, B. (1991). Comments on report of a joint FAO/WHO expert consultation on protein quality evaluation, Rome 1990. *Zeitschrift für Ernährungswissenschaft*, 30, 81-88.
7. Tuan, Y.H., Phillips, R.D. and Dove, C.R. (1999). Predicting integrated protein nutritional quality part 2: integrated protein nutritional quality predicted from amino acid availability corrected amino acid score (AACAAAS). *Nutrition Research*, 19, 1807-1816.
8. Schaafsma, G. (2000). The protein digestibility-corrected amino acid score. *The Journal of Nutrition*, Supplement, 1865S-1867S.
9. AOAC (2000). Official Method for the Analysis (15th edition.). Arlington, Washington DC: Association of Official Analytical Chemists.
10. SPSS Inc. (1999). Statistical Package for Social Science, Version 15.00. Chicago, IL, USA: SPSS Inc.
11. Acton, J.C. and Rudd, C.L. (1987). Protein quality method for seafood: in Seafood Quality Determination. Edited by Kramer and J. Liston. Amsterdam : Elsevier Sci. Publ.
12. Berge, P., Lepetit, J., Renerre, M. and Touraille, C. (1997). Meat quality traits in the emu (*Dromairus novohollandaie*) as affected by muscle type and animal age. *Meat Science*, 45, 209-212.
13. Richardson, R.I. and Mead, G.C. (1999). Poultry Meat Science, Poultry Science Symposium Series Volume Twenty-Five, CABI Publishing.
14. Zorba, O. and Kurt, S. (2006). Optimization of emulsion characteristics of beef, chicken and turkey meat mixtures in model system using mixture design. Ataturk University, Erzurum-Turkey.
15. Wattanachant, S., Benjakul, S. and Ledward, D.A. (2004). Composition, colour, and texture of Thai indigenous and broiler chicken muscles. *Poultry Science*, 83, 123-128.
16. Sales, J. (1995). Nutritional quality of meat from some alternative species. *World Review of Animal Production*, 30, 47-56.

17. Schwegert, B.S. (1987). The nutritional content and value of meat and meat product. In J.F. Price and B.S. Schweigert (Eds), *The Science of Meat and Meat Products* (3rd ed.) (pp. 275). Westport, CT, USA: Food and Nutrition Press, Inc.
18. Farmer, L.J. (1999). Poultry meat flavour. *Poultry Meat Science*, 25, 127-158.
19. Dawood, A. and Alhankal, M.A. (1995). Nutrient composition of Najdi camel meat. *Meat Science*, 39, 71-78.
20. Paul, A.A. and Southgate, D.A.T. (1978). McCance & Widowhood's. *The Composition of Foods*, 4th (revised and extended) ed. of MRC Special Report No.297. Elsevier/North-Holland Biomedical Press, Amsterdam.