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Research Paper

Proximate Composition and Fatty Acid Profile of Namakkal Quail-1

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ABSTRACT

The aim of this study was to evaluate the proximate composition and fatty acid profiles of Namakkal quail-1 meat. The birds were reared in cage system and they were fed with standard broiler starter mash up to 6 weeks of age. Twenty four birds were selected randomly (12 male and 12 female) at 4th and 6th week of age and they were slaughtered by the following standard method. From each carcass breast muscle samples were collected for the proximate and fatty acid analysis. Results showed that the moisture and gross energy had no significant ($p>0.05$) effect on age and sex of the birds. Crude protein and total ash had significant effect on both age and sex of the birds. Both were high at 4th week in male birds (23.38±0.53 and 1.56±0.08). The ether extract had significant effect only on age of the birds, which was high in 6th week birds (4.85±0.20). The fatty acid analysis showed that between age groups linolenic acid, palmitoleic acid, linoleic acid and DHA were differed significantly ($p>0.05$) while between sexes, linolenic acid, oleic acid and DHA showed significant ($p>0.05$) effect. Linoleic acid was high (27.30±0.03) in 4th week while DHA, linolenic acid and palmitoleic acid were high (1.20±0.08, 0.68±0.31 and 6.83±0.03) in 6th week birds. Between sexes, linoleic acid, linolenic acid, oleic acid and DHA (27.42±1.15, 1.30±0.11, 36.03±0.63 and 0.74±0.13) were high in female birds. The MUFA was high in 4th week birds while PUFA and omega-3 was high in 6th week birds. The MUFA and PUFA were high in male birds.

Keywords : *Proximate composition, Fatty acid profile, Quail meat*

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INTRODUCTION

The Japanese quail (*Coturnix coturnix japonica*) is a migratory game bird native to East Asia and Japan. The Japanese quail originally domesticated around the 11th century as a pet song bird in Japan (Howes 1964; Crawford 1990) and become popular meat species since by 1910 (Kayang *et al.* 2004). Japanese quail is a small size bird and there are two species of quail in India- the black-breasted quail found in jungle (*Coturnix coromandelica*) and the brown-coloured Japanese quail (*Coturnix coturnix japonica)* which is bred for meat and commercial quail production. During the year 1974, ICAR-Central Avian Research Institute imported Japanese quail from US Davis, California for diversification in India. Since then, lots of improvements have been made in their economic traits and husbandry practices through research. Like chickens, these birds are being used for food purpose in India.

Quail meat is a delicious white meat with extremely low skin fat and cholesterol value. It is rich in micronutrients and a wide range of vitamins including the B-complex, foliate and Vitamin E and K (Michael Imchen 2013). The percent edible meat content of Japanese quail is very high. The breast, leg and wing contain 37.3-38.7, 22.7-24.4 and 35.9-37.8 per cent respectively.The protein, moisture and fat content of raw quail meat are 20.54, 73.93 and 3.85 per cent, respectively (Panda *et al.*1987). Among the fatty acids, it has slightly more undesired saturated fats. However, it also has a higher content of the good polyunsaturated fatty acids. It is also a good source of phosphorus, iron and copper. Quail meat is tastier than chicken and has less fat content. It promotes body and brain development in children (Michael Imchen 2013). In order to improve the meat quality, a newer strain was developed by TamilNadu Veterinary and Animal Sciences University called Namakkal Quail-1 during the year 2006. It is a meat type commercial hybrid produced by 4 way crossing of Japanese quail. This hybrid quail attains an average weight of 250g at fifth week under ordinary farm condition. With the feed conversion ratio of 3.2, it can be reared with lesser capital layout and fetch quicker high return.

MATERIALS AND METHODS

A total 24 birds comprising of 12 males and 12 females of 4th and 6th week age groups were procured from Poultry farm Complex of Department of Poultry Science, Veterinary College and Research Institute, Namakkal and starved for 4 hours and slaughtered as per the standard procedure in the Department of Livestock Products Technology (Meat Science), Veterinary College and Research Institute, Namakkal. Quails were

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slaughtered by decapitation. Following a 5 min bleeding time, feathers were removed along with skin. Carcasses were eviscerated and deboned manually.

***Proximate composition*:** The proximate composition of quail meat was determined as per the methods recommended by AOAC (1997). The crude protein content was determined by the Kjeldhal method and the ether extract content was determined by the Soxhlet method. The ash content was determined by ashing the samples at 550-600°C for three hours. Moisture content was determined by drying the samples overnight at 100 ± 2°C. The gross energy was determined by calculated method.

Fatty acid estimation: For the analysis of the fatty acid profile, the meat was thawed at 5° C for 12 hours followed by lipid extraction (Folch *et al.* 1957). The fatty acid profile was determined according to Hartman and Lago (1973). A 5 ml sample of lipid extract was concentrated in a water bath at 45 °C with a gentle nitrogen stream followed by saponification with a solution of NaOH in 0.5 M methanol and methylation with NH_4Cl, methanol, and H_2SO_4. After methylation, 5 ml of hexane was added, and the solution agitated for 10 seconds to separate the esterified fatty acids. Three milliliters of the supernatant fraction (hexane and methylated fatty acids) was then removed and again concentrated in a water bath at 45 °C with a gentle nitrogen stream. This extract was diluted with 1 ml of hexane, and 1 µl of this solution was injected into a Focus CG- Finnigan model gas chromatograph with a flame ionization detector and a 100-m long, 0.25-mm internal diameter and 0.20-mm thick (Supelco, Bellefonte, PA) CP-Sil 88 capillary column (Varian). Hydrogen at 1.8 ml/min was used as the carrier gas. The oven was maintained at 70° C for 4 min and then the temperature was increased at the rate of 13°C/min to 175°C, which was maintained for 27 min and then increased at the rate of 4°C/min to 215° C, which was maintained for 9 min, and then increased at the rate of 7°C to 230°C, which was maintained for 5 min. The injector temperature was 250 °C and the detector temperature 300 °C.

RESULT AND DISCUSSION

The overall mean value of proximate composition of meat of 4th and 6th week birds is presented in Table1. Results of proximate composition showed that age and sex of the birds had non-significant ($p>0.05$) effect on moisture and gross energy contents of Namakkal Quail -1. But both these factors had significant effect on crude protein and total ash contents. Crude protein and total ash contents were higher in 4th week old male birds. The ether extract had significant effect due to the age of the birds, which was high in 6th week group. This finding was agreed with De Marchi *et al.* (2005) who reported that sex had significant effect on proximate composition of meat but the total ash and dry matter was high in female birds, with no sexual dimorphism for percentage protein. Castellini *et al*. (2002) reported that age effect was present only for protein not for dry matter, demonstrating that tissue protein deposition persisted after 150 days in chicken whereas in other native breeds the total ash content also increases as the age increases. Between sexes, controversy to this present study, there were no significant ($p>0.05$) difference in the proximate composition of the two sexes. The males had slightly higher dry matter and crude protein but lower in moisture and fat than the females. The higher fat content was probably as a result of changes in the physiological status of the birds (Ayorinde 1993). This higher moisture content was agreed with broilers, guinea fowl, duck and pigeons (Famuyioa 1988). The crude protein was high in 4th week birds. This might be due to that the birds are in growing stage, which utilizes more protein for their muscle development. Ether extract was high in 6th week birds, this shows that the growth had been stopped and the fat started to deposit. The increase in protein content always shows that lower moisture and fat content (Franco and Lorenzo 2013). While comparing the proximate composition of Namakkal quail-1 with chicken and Japanese quail, the Namakkal quail-1 shows higher proximate composition.

Table 1: Proximate composition of meat of Namakkal Quail- 1 at 4 and 6 weeks of age (Mean ± S.E.)

	4th week			6th week		
Parameters	**Male**	**Female**	**Overall mean**	**Male**	**Female**	**Overall mean**
Moisture	71.15±0.72	70.33±0.59	70.74±0.46	71.28±0.51	71.43±0.35	71.36±0.29
Crude protein	23.38±0.53 ^{b}	23.39±0.47 ^{a}	23.39±0.34^{x}	21.47±0.45 ^{b}	21.67±0.30 ^{b}	21.37±0.26^{y}
Ether extract	3.75±0.13	3.97±0.20	3.86±0.12x	4.85±0.20	4.62±0.52	4.73±0.26^{y}
Total ash	1.56±0.08	1.52±0.07	1.54±0.05^{x}	1.43±0.06^{a}	1.04±0.06^{b}	1.24±0.07^{y}
Gross energy	1689.00±34.38	1727.83±30.26	1708.41±22.60	1709.83±31.08	1710.00±41.02	1709.91±24.53

Means bearing different superscripts row-wise differ significantly ($p<0.05$)

Table 2: Fatty acid profile of meat of Namakkal Quail- 1 at 4 and 6 weeks of age (Mean ± S.E.)

	4th week			6th week		
Parameters	**Male**	**Female**	**Overall mean**	**Male**	**Female**	**Overall mean**
Myristic acid	0.64± 0.08	0.67±0.11	0.65±0.77	0.53±0.04	0.6±0.05	0.58±0.42
Palmitic acid	21.45±0.93	21.21±0.71	21.33±0.05	20.55±0.47	20.60±0.44	20.57±0.08
Stearic acid	7.69±0.87	6.45±0.49	7.07±0.05	7.48±0.37	6.19±0.58	6.83±0.07
Oleic acid	32.06±0.65^{b}	35.05±0.68^{a}	33.56±0.31	36.03±0.63^{a}	34.67±1.33^{a}	35.35±0.21
Linoleic acid	27.18±0.50^{a}	27.42±1.15^{a}	27.30±0.03^{x}	22.48±0.94^{b}	23.47±0.93^{b}	22.99±0.01^{y}
Linolenic acid	0.98±0.12^{b}	0.90±0.11^{b}	0.94±0.07^{x}	1.04±0.07^{b}	1.30±0.11^{a}	1.20±0.08^{y}
Arachidic acid	0.26±0.07	0.20±0.01	0.23±0.60	0.19±0.01	0.20±0.02	0.20±0.64
Behenic acid	3.58±0.35	2.56±0.45	3.07±0.63	3.48±0.18	3.88±0.39	3.68±0.73
EPA	0.45±0.16	0.32±0.04	0.38±0.51	0.46±0.13	0.37±0.05	0.42±0.38
DHA	0.39±0.08^{b}	0.31±0.07^{b}	0.35±0.56^{x}	0.61±0.09^{ab}	0.74±0.13^{a}	0.68±0.31^{y}
Palmitoleic acid	4.80±1.26	4.46±1.00	4.63±0.06^{x}	6.45±0.61	7.21±0.60	6.83±0.03^{y}
SFA	33.63±1.70	31.10±0.94	32.36±1.00	32.25±0.90	31.51±0.76	31.88±0.57
MUFA	36.87±1.61^{a}	39.52±0.86^{a}	38.20±0.95^{x}	78.41±0.73^{b}	77.49±0.96^{b}	79.95±0.59^{y}
PUFA	29.01±0.47^{b}	28.96±1.09^{b}	28.99±0.56^{x}	24.61±0.80^{a}	25.97±1.06^{a}	25.29±0.66^{y}
Omega-3 Fatty Acids	1.83±0.25^{ab}	1.54±0.19^{a}	1.68±0.15^{x}	2.12±0.29^{ab}	2.48±0.26^{b}	2.30±0.19^{y}

Means bearing different superscripts row-wise differ significantly ($p<0.05$)

Between age's linolenic acid, palmitoleic acid, linoleic acid and DHA showed significant ($p>0.05$) effect and between sexes, linolenic acid, oleic acid and DHA showed significant ($p>0.05$) effect. Linoleic acid was high in 4th week while DHA, linolenic acid and palmitoleic acid were high in 6th week birds. Between sexes, linoleic acid, linolenic acid, oleic acid and DHA were high in female birds. The oleic acid was the main fatty acid in Namakkal quail-1 meat followed by linoleic acid and palmitic acid but in chicken the main fatty acid orders varies oleic acid > palmitic acid> linoleic acid (De Marchi *et al*. 2005). This result was agreed with Pereira *et al*. (1976), Shell and Chen (2002) in chicken meat, Franco and Lorenzo (2013) reported in pheasant meat and Franco *et al*. (2012) reported in capons and ducks.

Between ages, on agreed with our report, De Marchi *et al*. (2005) reported that age had significant effect on fatty acid. As age increases, palmitic acid, oleic acid, myristic acid and EPA also increases. Among the fatty acids in Namakkal quail- 1, the contribution of oleic acid was lower than duck (37.1 per cent) and chicken (47.7 per cent) (De Marchi *et al*. 2005) but similar to Japanese quail (35.38 per cent) (Genchev *et al*. 2008).

Sex and age had significant effect on MUFA and PUFA. On omega-3 fatty acids, only the age of the birds had significant effect. The MUFA was high in 4th week birds while PUFA and omega-3 was high in 6th week birds. The MUFA and PUFA were high in male birds.

According to De Marchi *et al*. (2005), in Padovana breed of chicken the SFA, MUFA and PUFA were 35.30, 32.89 and 32.21 per cent and for pheasant meat 34.92, 44.03 and 24.58 per cent (Franco and Larenzo 2013), respectively. On comparing this with Namakkal quail-1, it contains 33.63 per cent SFA, 78.41 per cent MUFA and 29.01 per cent PUFA respectively. The Namakkal quail-1 was low in SFA and high in MUFA, PUFA and omega-3 fatty acid. This was supported by Ho *et al*. (2007) in chicken and *R.catesbeiana*, the MUFA was high which may be due to increase in oleic acid, but low in PUFA this was similar to cattle reported by Srinivasan *et al*. (1997). The omega-3 fatty acid of Japanese quail meat was 1.25 per cent, for duck 1.02 per cent and for broiler chicken 0.9 per cent, respectively (Ionita *et al*. 2011). Namakkal quail contain 2.48 per cent omega-3 fatty acid. On comparing these, Namakkal quail-1 has higher omega-3 fatty acids.

CONCLUSION

Based on the result of the present study it was revealed that, the 6th week Namakkal quail-1 has more advantages on meat quality than 4th week birds. The proximate composition does not show much difference between sex and age of the birds. The crude protein was high in 4th week birds because they are

in growing stage. Ether extract was high in 6th week birds this shows that the growth has been stopped and the fat started to deposit. Since the ether extract was high in 6th week birds, the PUFA, MUFA and Omega-3 fatty acid were also high in 6th week birds.

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