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. During the year 1974, Central Avian Research Institute imported Japanese quail from Davis, California for diversification in India. Since then lot of improvement have been made in their economic traits and husbandry practices through research. Like chickens, these birds are being used for food purpose in India. Several aspects account for the utility of birds. Such as, economic importance, low maintenance cost, smaller body size, short generation interval, resistance to disease and excellent laboratory animal. The economical age of marketing quail is about 5 weeks when they weigh nearly 200g with feed efficiency as 3.0. The physical and biochemical make up of meat will exert a profound influence on the shelf life and the response offered by the meat to processing. Most processing technologies have to contend with the quality of the raw product. A proper understanding of biochemical architecture of meat is essential in choosing proper material for slaughter, processing and for predicting quality of the product.

Central Avian Research Institute (CARI), being a nerve centre for quail production technology in India since 1974, has taken lead to develop a number of new strains. Moreover, many commercial quail crosses and their strains are available in the market creating a need to elucidate the changes in the physical and chemical characteristics of quail muscles of different crosses and strains. Among the many newer strains, a strain was developed by TamilNadu Veterinary and Animal Sciences University called Namakkal quail-1 which is mainly evolved for meat purpose by four way crossing of Japanese quail.

**MATERIAL AND METHODS**

Birds (48 Birds including 24 males and 24 females of 4th and 6th week birds) 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 slaughtered by decapitation. Following a 5 min bleeding time, feathers were removed along with skin by hand. Carcasses were eviscerated and deboned manually. The breast meat was used for further analysis.

**pH:** The pH of thigh muscles samples was determined by AOAC method. Five grams of meat sample was homogenized with 45 ml of distilled water for one minute. The pH of the sample was measured by Orion 3 Star pH meter.
meat was recorded by immersing combined glass electrode and temperature probe of the digital pH meter (Model 361, Systronics, India) directly into meat suspension.

**Water Holding Capacity (WHC):** The water holding capacity of the *Pectoralis major* muscle was estimated by measuring the amount of water released from muscle protein by the application of force. It measures the ability of muscle protein to retain water in excess and under the influence of internal force. The water holding capacity of breast muscles were determined with a modified version of the method. 300 mg. of meat sample was placed on a filter paper arranged between two glass slides. On the top of the upper glass slide 100gm weight was placed for 3 minutes. The released water from the meat sample was absorbed in the filter paper and leaves an impression. With the sharp pencil the boundary of the impression was clearly demarcated. The area of two resulted impression left as each half of the filter paper on account of oozing of fluid by application force (outer circle) and the area of the meat (inner circle) were measured by using graph and the percentage was calculated by using the formula.

\[
\text{Area of inner circle (area of meat)} \times 100
\]

\[
\text{Area of outer circle (impression by oozing of fluid from meat)}
\]

**Fibre Diameter (μm):** The average cross sectional dimensions of muscle fibre was measured for estimating fibre diameter. Fibre diameter was measured at the end of 24 hrs of storage at refrigeration temperature. Five grams of the breast meat (*Pectoralis superficialis*) was cut into small cubes and homogenized for two 15 seconds periods at low speed, interspersed with a five second resting interval in a solution containing 0.25 M sucrose and 1.0mM EDTA (Ethylene Diamine Tetra Acetic acid) to produce slurry. One or more drops of the slurry was transferred onto a microscope slide and covered with a cover slip. The suspension was examined directly under a light microscopic equipped with low object and 8x eye piece containing a calibrated micrometer. Muscle fibre diameter was measured as the mean cross sectional distance between the exterior surfaces of the sarcolemma of 20 randomly selected muscle fibres and expressed in micrometer.

**Sarcomere length (μm):** Sarcomere length was measured as per standard method with certain modifications. Five grams of meat sample was cut into small pieces and homogenized at low speed (approximately 5000 rpm) in 30 ml chilled sucrose solution (0.25 M) in mixer grinder for 60 second and add a drop of eosin strain. Then take a drop of the homogenate was transferred on a glass slide and examined under a phase contrast microscope (100x objective and 8x eye piece). The length was measured by using an ocular micrometer with a calibrated factor. The sarcomere length of 25 myofibrils was measured randomly and average was calculated.

**Shear force value (kg/cm²):** Shear force is the measure of tenderness of cooked meat by Warner-Bratzler meat shearer (G.R electrical manufacturing company). A Portion of breast muscle from the carcass was frozen at -10ºC to take a uniform 3/4 cm diameter core to study the objective evaluation of tenderness. The cores were then thawed and cooked in oil at 80ºC for two minutes and subsequently cooled on ice immediately to arrest the further cooking. From each muscle sample, two cores were obtained and three readings were recorded on each core. The average of these readings was considered as the shear force value, and the pressure exerted to shear the core was expressed in Kg.

**RESULTS AND DISCUSSION**

The overall mean pH values of 4th and 6th week birds were 6.05±0.03 and 5.98±0.02, respectively and the mean pH for male and female were 5.98±0.06 and 6.12±0.02 for 4th week and 6.00±0.02 and 5.96±0.03 for 6th week Namakkal Quail – 1 bird, respectively. The pH values of the meat are important and it depended on glycogen content in muscle, the glycogen store are highly influenced by the locomotor activity and the presence of stress factors in the pre slaughter period. The analysis of variance showed that age had no significant (P>0.05) effect but the sex had significant effect (P ≤ 0.05) on pH of the meat, the female birds shows higher pH value. This was agreed in 33 days old grey partridge. Sex had not affected the pH of the meat but female shows higher pH than males. The higher pH value was associated with the low glycogen content of meat at slaughter which prevented sufficient acidification of meat.

The water holding capacity was defined as the ability of meat...
Table-1. Mean (±) S.E. physico - chemical characteristics of 4 and 6 weeks old Namakkal Quail- 1

<table>
<thead>
<tr>
<th>Parameters</th>
<th>4th week Male</th>
<th>4th week Female</th>
<th>Overall mean Male</th>
<th>Overall mean Female</th>
<th>6th week Male</th>
<th>6th week Female</th>
<th>Overall mean Male</th>
<th>Overall mean Female</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>5.98±0.06 b</td>
<td>6.12±0.02 a</td>
<td>6.05±0.03</td>
<td></td>
<td>6.00±0.02</td>
<td>5.96±0.03</td>
<td>5.98±0.02</td>
<td></td>
</tr>
<tr>
<td>Water holding capacity (%)</td>
<td>54.70±2.08</td>
<td>56.43±2.01</td>
<td>55.56±1.42</td>
<td></td>
<td>60.53±2.16</td>
<td>57.32±2.17</td>
<td>58.93±1.53</td>
<td></td>
</tr>
<tr>
<td>Shear force value (kg/cm²)</td>
<td>1.35±0.09 b</td>
<td>1.34±0.10 b</td>
<td>1.35±0.06 a</td>
<td></td>
<td>1.90±0.08 ab</td>
<td>1.65±0.14 n</td>
<td>1.77±0.08 y</td>
<td></td>
</tr>
<tr>
<td>Fibre diameter (µm)</td>
<td>39.40±1.10 c</td>
<td>34.34±1.27 b</td>
<td>36.87±0.97 a</td>
<td></td>
<td>45.02±1.45 a</td>
<td>45.24±1.18 a</td>
<td>45.13±0.91 y</td>
<td></td>
</tr>
<tr>
<td>Sarcomere length (µm)</td>
<td>1.14±0.61 b</td>
<td>1.12±0.96 b</td>
<td>1.13±0.55 a</td>
<td></td>
<td>1.21±0.64 c</td>
<td>1.40±0.76 b</td>
<td>1.35±0.80 y</td>
<td></td>
</tr>
</tbody>
</table>

Means bearing different superscripts differ significantly (P < 0.05).

to retain its water upon application of external forces is a primary indicator of the degree of juiciness of meat\(^1\). The WHC of 4th and 6th week Namakkal Quail was 55.56±1.42 and 58.93±1.53, respectively. The mean water holding capacity values for male and female were ranged between 54.70±2.08 and 60.53±2.16, respectively. The sex and age had no significant (P>0.05) effect on WHC of the meat. This was agreed by a report in duck wherein the sex had no effect on WHC of meat\(^1\). The WHC in duck was 72.69 to 76.72 per cent, for Japanese quails 66.37-69.87 per cent, for chicken 69.03-66.01 per cent, for grey partridge 77.1-78.8 per cent and for Namakkal quail was 54.70 – 60.53 per cent, which was lower than Japanese quail, chicken and duck\(^8,11-13\). The good water holding capacity of meat guarantees excellent technological properties of meat. The lower water holding capacity of Namakkal quail-1 meat may be related to slightly lower pH values.

The fibre diameter of 4th and 6th week Namakkal Quail–1 bird was 36.87±0.97 and 45.13±0.91, respectively. The mean fibre diameters for male and females were 39.40±1.10 and 34.34±1.27 for 4th week birds and 45.02±1.45 and 45.24±1.18 for 6th week birds, respectively. The muscle fibre diameter of Namakkal Quail-1 showed that, sex and age of the birds had highly significant (P < 0.01) effect on fibre diameter. The 6th week birds and female birds showed higher fibre diameter. In controversy to this, a report stated that males have higher fibre diameter than females in commercial broiler chicken\(^14\). Similar trend was reported in beef carcass, Longissimus dorsi muscle fibre diameter was high in bull then steer and heifer and also reported that as the aging time increases the diameter reduces\(^15\). Between ages, on agreed with this, a report states that in chicken as the age increases the fibre diameter also increases\(^16\). It was observed that in chicken as the age increases the muscle volume increases, which are resulted from enlargement in fibre diameter\(^17\).

The fibre diameter of chicken was 20µm, for goat 22µm, for pigs 40 to 80 µm, for duck 39.76 to 49.89µm, for buffalo 26 µm and for cattle 55 to 67 µm, respectively\(^18-21\). On comparing these with Namakkal quail-1, the fibre diameter range between 34.34 µm to 45.14 µm, which is lower than pig and cattle but higher than chicken, goat, and buffalo and similar to duck. This shows that faster growing animals have higher fibre diameter than slow growing animals.

The sarcomere length was 1.13±0.55 and 1.35±0.80 for 4th and 6th week birds, respectively. The mean sarcomere lengths for male and female were 1.14±0.61, 1.12±0.96, 1.21±0.64 and 1.40±0.76 for 4th week male and female and 6th week male and female birds, respectively. The analysis of variance showed that sarcomere length was significantly (P < 0.05) affected by the sex and age of the birds. The sarcomere length was high in 6th week birds and female birds. On agreed with this, a report stated that sex had significantly affect the sarcomere
length in beef carcass\textsuperscript{15}. The females showed higher sarcomere length than males and also reported that, as the sarcomere length increases as the ageing time increases. Between ages, controversy to this in bulls’ age had no significant effect on sarcomere length. Several other factors affect the sarcomere length of the muscle; they are pH, colour and shear force value of meat. The pH of the muscle had positive correlation with the sarcomere length. In bulls as the pH increases the sarcomere length also increases in general it influences the meat quality\textsuperscript{23}. The sarcomere length of duck meat ranged between 1.84 to 1.88 µm, for pork 3.28 µm, for boar 2.51 µm and for Japanese quail 1.23 µm, respectively. In Namakkal quail-1 it ranges between 1.12µm to 1.40 µm, which is lower than all other meat\textsuperscript{23}.

Shear force values are the important factors in predicting the tenderness of the meat. The mean shear force values were 1.35±0.66 and 1.77±0.08 for 4\textsuperscript{th} and 6\textsuperscript{th} week birds’ meat, respectively. The mean shear force values were 1.35±0.09 and 1.34±0.10, 1.90±0.08 and 1.65±0.14 for male and female of 4\textsuperscript{th} and 6\textsuperscript{th} week Namakkal Quail-1 birds’ meat. The analysis of variance showed that age and sex of the birds significantly (P ≤ 0.01) affect the shear force value of the meat. The shear force value was high in 6\textsuperscript{th} week birds and between sexes; it was high in male birds. This difference may be due to several factors like a difference in the physiological maturity of the birds at the time of harvest may result in a difference in collagen cross linking. As the age increases the collagen cross linkage also increases and it also associated with toughness of the meat\textsuperscript{24}. In this present study, males had significantly higher shear force value than the females and this was agreed with a report stating that male birds had significantly higher (5.9kg/cm\textsuperscript{2}) than females (5.2kg/cm\textsuperscript{2})\textsuperscript{25}. The lower value in females might be due to difference in “finish”. The greater value might be due to greater amount of fat and moisture losses by the males during cooking. Similar to this, in beef, it was reported that sex of animals was a significant factor in beef tenderness\textsuperscript{26}. Meat from bulls was tougher than that from heifer. The tenderness of broiler breast of birds slaughtered at 5, 6, 7 and 8 weeks of age and found that shear force value increases with age, which was agreed with this report\textsuperscript{27}.

CONCLUSION

Based on the result the physico chemical characteristics showed difference between age and sex. The fibre diameter and sarcomere length were high in 6\textsuperscript{th} week birds while the shear force value was high in 4\textsuperscript{th} week birds, this shows that the meat from 4\textsuperscript{th} week birds was tenderer than the 6\textsuperscript{th} week birds. Hence it was concluded that, since the Namakkal Quail-1 was mainly evolved for meat purpose, it had high meat yield and more tender meat in short duration of time of 4 weeks. So Namakkal quail-1 meat can be preferred over other meat.

REFERENCES


