EFFECT OF FROZEN STORAGE ON THE PHYSICO-CHEMICAL QUALITY AND HISTOLOGY OF QUAIL BREAST MEAT

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ABSTRACT

This experiment was carried out to study the effect of frozen storage on the physico-chemical quality of quail breast meat. Six weeks old broiler quails were collected, slaughtered, dressed hygienically. Quail breast meat samples were collected from dressed carcass which was packed in low density polyethylene pouches taking optimum care to avoid contamination and stored at -18 ± 2°C for 60 days. Fresh as well as frozen quail breast meat samples were evaluated for physico-chemical and histological changes. Frozen meat samples were analyzed after thawing at 4 ± 1°C for 12 hrs at an interval of 15, 30, 45 and 60 days. It was observed that with advancement of the frozen storage period pH, TBA value, tyrosine value and drip loss increased, whereas moisture, protein, fat and ERV content of quail meat decreased. Pronounced structural changes reported at later part of storage in histological study due to formation of ice crystals in the muscles. It shows that quail meat can be safely stored for 60 days in frozen state without any marked changes.

Key words: - Frozen storage, quail breast meat, fresh and frozen meat and quality changes

INTRODUCTION

Quails are distributed worldwide over large areas of Asia, Europe and Africa, but they were first domesticated in Japan. Little Japanese quail (Coturnix coturnix Japonica) has been introduced to the Indian sub-continent as an alternative of avian species from last two decades to mitigate chronic protein deficiency among the Indian population. In India domesticated quails differ from wild species which are protected under the Wild Life Protection Act, (1972). Quails are most commonly bred and reared for human consumption. In world profile quail meat has been known for centuries, and there are even biblical quotations of their use as a meat source. Broiler quails are slaughtered at about six weeks of age (Boni et al, 2010). Quail meat is an authenticated ideal food, which is tender, very delicious with low calorific value and high dry matter. Moreover the nutritional as well as medicinal value of quail meat is very high. Quail meat, particularly the breast fillet is very lean. The essential amino acids content of quail breast meat is 6.5 % higher than leg meat

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especially isoleucine and valine concentration (Genchev et al., 2008). Quail has unique qualities like hardness and adaptability to diversified agro-climatic conditions. Earlier the development and popularization of quail meat was not possible due to ban on captivation of domestic quails, but now because of lifting of ban quail industry is in emerging stage and in future it has tremendous scope to occupy a considerable portion of poultry meat. Due to many unavoidable circumstances during marketing such as delay during transportation and fluctuation in market rates, consumers demand, quail meat is subjected to freezing till it reaches to retailer. Indian has more demand for fresh meat than frozen meat, which fetches higher price than that of frozen meat. Generally some of the retailers take disadvantage of the difference in the price by mixing frozen meat with fresh meat. It is necessary to find out such malpractices carried during sale of meat in the market for the protection of consumer health and interest, therefore the study was aimed to study the effect of frozen storage (-18 ± 2°C) on physico-chemical quality of quail breast meat.

MATERIALS AND METHODS

Six weeks old broiler quails were collected from quail farm located at College of Veterinary and Animal Sciences, Parbhani. After collection of live quails, they were slaughtered, dressed hygienically to avoid contamination. Breast meat samples were collected, immediately washed with clean water and kept in a chiller (4 ± 1°C) for ageing. The deboning as well as fat separation of meat samples was carried out under hygienic condition. These samples were cut into small pieces for packaging in low density polyethylene pouches taking optimum care to avoid contamination and stored in a freezer at -18 ± 2°C temperature for 60 days.

Fresh and frozen quail breast meat samples were analyzed for the physico-chemical quality. During this study, the frozen meat samples were removed from the freezer at an interval of 15, 30, 45 and 60 days of storage period, thawed for 12 hrs at refrigeration temperature (4 ± 1°C) and processed for the study. The Moisture, fat and protein content of quail breast meat were determined using standard procedure described by A.O.A.C., (1995). The pH of quail breast meat was determined using digital pH meter (Model; Li 120, ELICO Ltd. Hyderabad). Drip loss was calculated by measuring the exudates of meat juices after thawing the samples for 12 hrs at 4 ± 1°C. As per the extraction method suggested by Witte et al (1970) TBA value was estimated. The procedure of Strange et al (1977) was followed with slight modification for determination of tyrosine value and ERV. Samples of fresh and frozen-thawed meat having 0.5 mm thickness were fixed in 10% formalin for histological study. The formalin fixed tissues were processed and embedded in paraffin blocks. The paraffin sections of 4 - 5 µ were cut by conventional method. The micro-sections were stained by haematoxylin and eosin stain and examined under microscope to know the structural changes in muscle. The data obtained during the study were subjected to statistical analysis using Completely Randomized Design (CRD) described by Snedecor and Cochran (1989).

RESULTS AND DISCUSSION

Proximate composition: The observations with respect to the changes in the proximate composition of quail breast meat during frozen storage noted in Table 1. The moisture content


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of quail breast meat decreased significantly (P<0.05) with progress of frozen storage period. The moisture content of fresh quail breast meat was 71.70 percent which decreased to 69.77 percent on 15th day, thereafter declined gradually to 62.80 percent on 60th day. Similar declining trend in moisture content was recorded by Brewer and Harbers (1991) for ground pork under frozen condition. The decrease in water retention of meat during frozen storage may be due to myofibrillar distortion and sublimation of surface water (Taylor et al., 1990). Protein content of quail breast meat decreased gradually with progress of storage period. Results showed that protein content of frozen quail breast meat on 0, 15th, 30th day of storage did not differ significantly but at the end of storage period (60 days) protein content differed significantly (p<0.05). The observations were in agreement with Arannilewa et al. (2005) for frozen tilapia fish. The decrease in protein content may be attributed to degradation of amino acids by proteolytic enzymes produced by bacteria especially at the later part of frozen storage (Dainty et al., 1975). Similarly fat content of frozen quail breast meat decreased with progress of storage period. Fat content of quail breast meat had decreased non-significantly up to 15th day of frozen storage, thereafter the fat content of quail breast meat was differed significantly (p<0.05) with increase in storage period. Fat content of quail breast meat decreased with progress of storage period. Fat content of quail breast meat was differed significantly (p<0.05) up to 30th day and on 60th day of frozen storage but there is no significant rise in pH between 30th and 45th day of storage. Similar findings were recorded by Chung et al. (1981) for frozen chicken, Sen (1996) for frozen beef, Doifode (2007) for frozen chevon, Kandeepan and Biswas (2007) for frozen buffalo meat and Swami (2011) for frozen rabbit meat. Significant increase in pH during prolonged frozen storage may be attributed to autolysis of meat (Strange et al., 1977) and it may be also due to microbial spoilage of meat (Dainty et al. 1975).

In this study, thiobarbituric acid values of quail breast meat increased significantly (p<0.05) with advancement of frozen storage period. On the 0 day, TBA value of quail breast meat was in the range of 0.11 to 0.13 mg of malonaldehyde/kg with a mean value of 0.12 ± 0.01 mg of malonaldehyde/kg which increased gradually to 0.56 mg of malonaldehyde/kg on 60th day of frozen storage. Brewer and Harbers (1991), Jayesh and Venkataramanujam (2002), Sen and Sharma (2003), Doifode (2007), Kandeepan and Biswas (2007) and Swami (2011) also

During the study, results obtained for moisture, protein, fat of quail breast meat were similar to the observations of Doifode (2007), Kandeepan and Biswas (2007), Swami (2011) for chevon, buffalo meat and rabbit meat respectively under frozen storage condition.

Physico-chemical changes: Changes in pH, TBA, Tyrosine values of frozen quail breast meat recorded in Table 2. There was gradual increase in pH of quail breast meat samples with increase in frozen storage period which was also observed by Jayesh and Venkataramanujam (2002). pH of quail breast meat was increased significantly (p<0.05) up to 30th day and on 60th day of frozen storage but there is no significant rise in pH between 30th and 45th day of storage. Similar findings were recorded by Chung et al. (1981) for frozen chicken, Sen (1996) for frozen beef, Doifode (2007) for frozen chevon, Kandeepan and Biswas (2007) for frozen buffalo meat and Swami (2011) for frozen rabbit meat. Significant increase in pH during prolonged frozen storage may be attributed to autolysis of meat (Strange et al., 1977) and it may be also due to microbial spoilage of meat (Dainty et al. 1975).
observed similar results for different species of meat. Anand et al. (1999) also noticed consistent rise in TBA with progress of storage period. The increase in TBA value during storage period was mainly attributed to the oxygen permeability of packaging material (Sen, 1996) whereas Strange et al. (1977) reported that TBA number may increase due to lipid oxidation and not specifically due to bacterial action.

Tyrosine values of frozen stored quail breast meat samples were significantly (p<0.05) higher than the fresh meat sample. The tyrosine value increased gradually but consistently from initial value 18.17 mg/100 gm to 31.17 mg/100 gm on 60th day. These findings were in close agreement with Jayesh and Venkatramanujam (2002) for mutton, Doifode (2007) for chevon, Kandeepan and Biswas (2007) for buffalo meat and Swami (2011) for rabbit meat. The increase in tyrosine value of meat may be due to intrinsic (autolysis) changes in meat and bacterial action (Agnihotri, 1998; Dainty et al., 1975; Strange et al., 1977).

Drip loss of quail breast meat increased significantly (p<0.05) with prolonged frozen storage period of 60 days. Initially the drip loss was zero which increased gradually with advancement of frozen storage period. These findings were in close agreement with Ambrosiadis et al. (1994), Steven et al. (1998), Strange et al. (1987), and Ziauddin et al. (1993). Similar results regarding increase in drip loss during frozen storage were observed by Kandeepan and Biswas (2003) for buffalo meat, Doifode (2007) for chevon and Swami (2011) for rabbit meat. The increase in drip loss may be due to several factors such as shortening of the sarcomere (Honikel et al., 1968), the degree of distortion of fat and water translocation (Ramsbottom and Koonz, 1939), increased enzyme activity etc. (Strange, 1987). An extract release volume (ERV) of frozen quail breast meat decreased gradually with increase in storage period which differ significantly (p<0.05). Extract release volume of fresh meat sample was 28.33 ml which decreased consistently up to 17.33 ml on 60th day of frozen storage. Similar findings were recorded by Jayesh and Venkatramanujam (2002) for frozen mutton, Doifode (2007) for frozen chevon and Swami (2011) for frozen rabbit meat. Cut off limit of ERV is 17 ml (Pearson, 1968) which is indicative of spoilage. The decrease in ERV during frozen storage may be very well correlated to increase in pH and TBA values.

**Histological changes:** The histological studies of fresh quail breast meat did not observe any appreciable changes in the muscle fibres (Plate 1), while remarkable histological changes were observed in the quail breast meat during frozen storage. The samples of 15th day of frozen storage processed for histological studies after thawing at refrigeration temperature for 12 hrs revealed separation of muscle groups and muscle fibres with mild kinking and initiation of breakage in muscle fibres (Plate 2). The muscles showed increased separation of muscle fibres leading to increase in longitudinal spaces with transverse breakage on 30th day of frozen storage (Plate 3). The transverse breaks in the muscle fibres during frozen storage might be due to physical stress produced by contraction and by action of proteolytic enzymes (Kandeepan and Biswas, 2006). The histology of the muscles on 45th day of frozen storage showed more separation of muscle fibres than 30th day of frozen storage with pronounced shrinkage and tearing of muscle fibres (Plate 4). On 60th day of frozen storage, histology of muscles revealed great separation of muscle groups and muscle fibres.
with increased structural damage (Plate 5). The severe structural damage may be due to intracellular ice crystals thus exerting pressure in opposite direction and more tearing of muscle fibres. Three major possibilities of damage during freezing of muscle are intracellular puncture or rupture by formation of ice crystals, damage to the cell by production of increased osmotic pressure and invisible precipitation or denaturation of the colloidal cell constituents (Kandeepan and Biswas, 2006). The changes observed during histological study of fresh and frozen quail breast meat are in close agreement with those reported by Kandeepan and Biswas (2006) for buffalo meat, Doifode (2007) for chevon and Swami (2011) for rabbit meat.

From the study, it is concluded that quail meat can be safely stored for 60 days in frozen state without any marked changes in composition and physico-chemical properties and histology.

Table 1. Mean ± S.E. of proximate composition of fresh and frozen (-18±2°C) quail breast meat.

<table>
<thead>
<tr>
<th>Compositional parameters</th>
<th>Fresh meat</th>
<th>Storage period (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0</td>
<td>15</td>
</tr>
<tr>
<td>Storage period</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Moisture (%)</td>
<td>71.70 ± 0.46</td>
<td>69.77 ± 0.26</td>
</tr>
<tr>
<td>Protein (%)</td>
<td>20.83 ± 0.57</td>
<td>19.86 ± 0.63</td>
</tr>
<tr>
<td>Fat (%)</td>
<td>3.13 ± 0.07</td>
<td>2.93ab ± 0.09</td>
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</tbody>
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*values in rows with different superscripts differ significantly (p<0.05).
Each value is mean of five replicates
Table 2. Changes in physico-chemical quality frozen (-18±2°C) quail meat.

<table>
<thead>
<tr>
<th>Quality parameters</th>
<th>Fresh meat</th>
<th>Storage period (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>pH</td>
<td>5.67±0.07</td>
<td>5.90±0.06</td>
</tr>
<tr>
<td>TBA value (mg malonaldehyde /kg)</td>
<td>0.12±0.01</td>
<td>0.18±0.01</td>
</tr>
<tr>
<td>Tyrosine value (mg/100gm)</td>
<td>18.17±0.14</td>
<td>21.03±0.12</td>
</tr>
<tr>
<td>Drip loss (%)</td>
<td>Zero</td>
<td>2.29±0.07</td>
</tr>
<tr>
<td>Extract Release Volume (ml)</td>
<td>28.33±0.67</td>
<td>26.33±0.34</td>
</tr>
</tbody>
</table>

*values in rows with different superscripts differ significantly (p<0.05).
Each value is mean of five replicates

Fig 1: Proximate composition of frozen (-18±2°C) quail breast meat.
Fig 2. Changes in the physico-chemical quality of frozen (-18±2°C) quail meat

Plate 1- The section of fresh quail breast muscle showing normal histological structure (H&E, 10X)

Plate 2- The section of quail breast muscle showing separation of muscle fibres and gap in inter-fibrillar space on 15th day of frozen (H&E, 10X)
Plate 3- The section of muscle showing increased separation of muscle groups and muscle fibres on 30th day of frozen storage (H&E, 10X)

Plate 4- The section of quail breast muscle showing more separation of muscle groups and break in muscle fibres on 45th day of frozen storage (H&E, 10X)

Plate 5- The section of muscle Showing great separation of muscle groups and break in the continuity of muscle fibres on 60th day of frozen storage (H&E, 40X)
REFERENCES


Effect of frozen storage on the physico-chemical quality and histology


