Qualitative and Quantitative Comparison of Desi Chicken, Broiler Chicken and Japanese Quail Eggs

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ARTICLE INFO

Article History:
Received 10 July 2015
Received in revised form 15 July 2015
Accepted 24 July 2015
Available online 30 July 2015

Key words:
Qualitative, quantitative, Haugh unit, exotic, desi, Japanese quail.

ABSTRACT

The external and internal egg quality of egg were compared by analyzing characteristic and proximate chemical composition of the different source, namely, desi (Brown Shell), exotic (White Shell) and Japanese quail (Mottled Brown Shell). Three trays of each containing 30 eggs from each color were randomly collected from Namakkal area of Tamilnadu, India. These egg groups were individually weighed and the qualitative analysis of internal and external egg qualities like albumen index (AI) yolk index (YI), yolk color grade (YC), haugh unit values (HU), shell weight per unit of egg surface area (SWUSA), shape index (SI), shell weight (SW), shell thickness (ST), egg surface area (SA) and specific gravity (SG) of each individual egg were measured. Quantitative analyses like yolk cholesterol and albumin crude protein were measured in three groups followed by standard procedure. The results shows that in quail eggs shape index (SI), albumen index (AI), yolk index (YI) were increased, but they showed insignificant difference and the specific gravity (SG) and Haugh unit values (HU) were significantly \( P<0.05 \) higher when compare to other eggs. In qualitative analysis of shell, albumen and yolk weight % as well as external and internal egg quality character on different sources of eggs shows significantly \( P<0.05 \) differences. In quantitative analysis of yolk cholesterol was significantly decreased and then albumin crude protein level was significantly higher on quail eggs when compared to the eggs of desi and exotic chicken. This study pivots for qualitative and quantitative analysis of Japanese quail egg showed good nutritional food, may be a good potential solution the world food problem for developing countries.

Introduction

In 20th century poultry keeping has become an important small scale industry due to modern need for palatable and nutritious food which it provides in the form of eggs as well as adult animals. The storage and transport facilities also have helped to a very great extent in its becoming popular as a trade. In country like India the increased egg consumption is essential for the proper nutrition of human being. The researches carried out at the Imperial Research Institute, Izatnagar have demonstrated the high biological value of eggs and recommended the consumption of eggs in supplementing the human diets. Through, there are several government poultry forms in India but the poultry is almost entirely in the hands of poor persons thus the eggs are available (Rola et al., 2006). Economically important egg quality traits were continuous changeability such as quantitative traits of weight, size, yolk and albumen (Das, 1994). Still, quail eggs are a specialty food item often found in Asian markets or food shops. Quail eggs are about one-quarter the size of chicken eggs, but have a similar flavor. The taste of quail eggs is considered to be fairly similar to chicken eggs, and they make a perfect sized meal for children.

The most of the human consumed is the chicken egg, typically unfertilized. Moreover, In Asian countries which consume quail eggs, earlier study reported that quail eggs are packed with vitamins and minerals even with their small size, their nutritional value is three to four times greater than chicken eggs. Regular consumption of quail eggs helps fight against many diseases of digestive tract disorders such as stomach ulcers and help with anemia by increasing the level of hemoglobin in the body (Applegate, 2000). The current study was aimed to compare the qualitative and quantitative parameter of desi chicken, exotic chicken and Japanese quail eggs.

Material and Methods

The experiment materials comprised eggs of Desi (Brown Shell), Exotic (White Shell) and Japanese quail (Mottled Brown Shell) eggs, which were purchased from the commercial farms at Namakkal, Tamilnadu, India. Three trays each containing 30 eggs from each color were randomly collected. Each egg was weighed through the 0.01 gm sensitive electronic scale. The weight of the each

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Table - 1: Comparison of external egg quality character on Desi, Exotic and Japanese Quail eggs

<table>
<thead>
<tr>
<th>Qualitative Test</th>
<th>Brown Shell Egg</th>
<th>White Shell Egg</th>
<th>Quail Egg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Egg Weight (gm)</td>
<td>39.54±1.35ab</td>
<td>57.35±2.01a</td>
<td>12.40±0.64bc</td>
</tr>
<tr>
<td>Egg Length (mm)</td>
<td>5.17±0.05b</td>
<td>5.79±0.06a</td>
<td>3.34±0.08c</td>
</tr>
<tr>
<td>Egg Width (mm)</td>
<td>3.74±0.03b</td>
<td>4.28±0.05a</td>
<td>2.64±0.04bc</td>
</tr>
<tr>
<td>Shell Weight (gm)</td>
<td>5.35±0.17a</td>
<td>6.74±0.29a</td>
<td>1.42±0.10b</td>
</tr>
<tr>
<td>Shell Thickness (mm)</td>
<td>0.48±0.01a</td>
<td>0.43±0.03bc</td>
<td>0.27±0.01c</td>
</tr>
<tr>
<td>Specific gravity</td>
<td>1.09±0.21a</td>
<td>1.08±0.19abc</td>
<td>1.07±0.18bc</td>
</tr>
<tr>
<td>Surface area(cm²)</td>
<td>72.65±0.42a</td>
<td>68.94±0.34b</td>
<td>22.4±0.16c</td>
</tr>
<tr>
<td>SWUSA(mg/cm²)</td>
<td>83.26±0.42a</td>
<td>81.72±0.36ab</td>
<td>76.04±0.22c</td>
</tr>
</tbody>
</table>

Means ± S.E followed by the a, b, c superscript letters in each row are significant (P<0.05) differ.

Table - 2: Comparison of Internal egg quality character on Desi, Exotic and Japanese Quail eggs

<table>
<thead>
<tr>
<th>Qualitative Test</th>
<th>Desi Egg</th>
<th>Exotic Egg</th>
<th>Japanese quail Egg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Albumen weight(gm)</td>
<td>20.94±1.13ab</td>
<td>34.76±1.24a</td>
<td>6.96±0.37a</td>
</tr>
<tr>
<td>Albumen length(mm)</td>
<td>10.15±0.47ab</td>
<td>10.61±0.52a</td>
<td>4.91±0.22b</td>
</tr>
<tr>
<td>Albumen width(mm)</td>
<td>9.37±0.76c</td>
<td>7.90±0.63b</td>
<td>3.39±0.11c</td>
</tr>
<tr>
<td>Haugh Unit (%)</td>
<td>81.68±11.28ab</td>
<td>77.78±13.28c</td>
<td>83.89±0.52a</td>
</tr>
</tbody>
</table>

Means ± S.E followed by the a, b, c superscript letters in each row are significant (P<0.05) differ.

Table - 3: Comparison of Internal egg quality character on Desi, Exotic and Japanese Quail eggs

<table>
<thead>
<tr>
<th>Qualitative Test</th>
<th>Desi Egg</th>
<th>Exotic Egg</th>
<th>Japanese quail Egg</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yolk weight (gm)</td>
<td>13.12±0.37b</td>
<td>15.77±0.62a</td>
<td>3.94±0.27c</td>
</tr>
<tr>
<td>Yolk length(mm)</td>
<td>4.24±0.14a</td>
<td>4.11±0.17ab</td>
<td>2.30±0.06c</td>
</tr>
<tr>
<td>Yolk width(mm)</td>
<td>4.42±0.14a</td>
<td>4.14±0.17b</td>
<td>2.33±0.06c</td>
</tr>
<tr>
<td>Yolk color</td>
<td>8.62±1.20a</td>
<td>7.21±1.12ab</td>
<td>3.04±0.51c</td>
</tr>
</tbody>
</table>

Means ± S.E followed by the a, b, c superscript letters in each row are significant (P<0.05) differ.

Table - 4: Comparisons of quantitative analysis on yolk cholesterol and albumen crude protein on Desi, Exotic and Quail eggs

<table>
<thead>
<tr>
<th>Experimental Eggs</th>
<th>Quantitative Analysis</th>
<th>Yolk Cholesterol %</th>
<th>Albumen Protein %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Desi Egg</td>
<td>369.77±29.85ab</td>
<td>4.5±0.06bc</td>
<td></td>
</tr>
<tr>
<td>Exotic Egg</td>
<td>370.50±32.36a</td>
<td>3.5±0.46c</td>
<td></td>
</tr>
<tr>
<td>Quail Egg</td>
<td>14.02±0.9c</td>
<td>11.98±0.58a</td>
<td></td>
</tr>
</tbody>
</table>

Means ± S.E followed by the a, b, c superscript letters in each row are significant (P<0.05) differ.
Figure - 1: Photograph of typical eggs of Desi, Exotic fowl and Japanese Quail

Figure - 2: Comparison of qualitative analysis of Shape, Albumen and Yolk Index on Desi, Exotic and Quail eggs

Figure - 3: Comparison of qualitative analysis Shell, Albumen and Yolk Weight % on Desi, Exotic and Quail eggs
egg, albumen, yolk and shell were calculated in relation to egg weight and expressed as a percentage.

**External egg quality**
A vernier caliper was used for external quality measuring length and width of the egg. Shell thickness was measured at three different locations, namely, equatorial region, broad end and narrow end by using a shell thickness measuring micro screw gauge and mean thickness was calculated. The egg weight, shape index, shell weight, shell weight%, shell thickness and specific gravity were determined for collected from 3 different particle sizes (Desi, Exotic and Japanese quail) of eggs. Shape index was worked out according to the formula of Shuttz (1953).

\[
\text{Shape Index} = \frac{\text{Egg width}}{\text{Egg length}} \times 100
\]

Egg surface area (SA) in cm\(^2\) was calculated for each egg using the following equation suggested by Nordstrom and Qusterhout (1982):

\[
\text{SA} = 3.9782 \times \text{egg weight}^{0.7856}
\]

Shell weight per unit of surface area (SWUSA) was also determined using the following equation suggested by Nordstrom and Qusterhout (1982):

\[
\text{SWUSA} = \frac{\text{Shell weight}}{\text{Surface area}}
\]

**Internal egg quality**
Internal egg quality after breaking open the egg, height of the thick albumen and yolk were recorded with a triploid stand micrometer and the width of the thick albumen was measured at two places, namely, near to yolk albumin, end of thick albumen and their mean width was calculated. Length of the albumen and yolk were determined using by vernier caliper. Yolk color intensity was evaluated and visually compared to the color numbers in ‘Roche yolk color fan’. Albumen weight, albumen weight %, yolk weight, yolk weight % was determined for collected from 3 different particle sizes (Desi, Exotic and Japanese quail) of eggs.

Albumen Index was calculated according to the formula of Heiman and Carver (1936).

\[
\text{Albumen Index} = \frac{\text{Height of albumen}}{\text{Weight of albumen}} \times 100
\]

Yolk Index was calculated according to the formula of Sharp and Powell (1930) and Funk (1948)

\[
\text{Yolk Index} = \frac{\text{Height of yolk}}{\text{Width of yolk}} \times 100
\]

**Haugh unit (HU)**
International quality of the Haugh unit scores for each individual egg according to Haugh (1937). Haugh Unit score of collected eggs were determined using the formula:

\[
\text{Haugh Unit} = 100 \times (H + 4.16) - (0.19W^{0.65})
\]

Where, \(h\) = observed albumen height in mm
\(w\) = observed weight of the egg in gm.

**Yolk cholesterol**
Yolk cholesterol were extracted by the method of Folch et al., (1956) as modified by Washburn and Nix (1974) from three eggs of each different (Desi, Exotic and Japanese quail) type laying chick eggs.

**Albumen crude protein**
Protein content of food stuff is estimated ultimately by first determining the nitrogen content. Albumen crude protein was extracted using the procedure of digestion and distillation. The total nitrogen present in a sample is determined by the Kjeldahl method (Kjeldahl, 1883).

**Statistical Analysis:**
Data were analyzed by one-way ANOVA (P<0.05) with completely randomized design. Comparison of parameters was performed with the Duncan’s multiple range test and data were analyzed using the SPSS software (version 16.0) computing program (Duncan, 1955).

**Results and Discussion**

**External character of eggs**
Comparison of external egg quality character on whole egg weight, egg length, egg width, shell weight were significantly (P<0.05) high in exotic when compared to desi and Japanese quail egg (Table 1). The three different source of eggs on desi, exotic and quail eggs weight were significantly (P<0.05) different, in that exotic egg shows significantly high weight when compared to desi and quail eggs, respectively (Table 1). Similar result confirmed also by Romanoff et al. (1949), Song et al. (2000) and Saiful et al. (2010). They reported that weight of yolk, albumen and shell were also different among species and showed the same trend as the whole egg weight.

In generally birds eggs have oval shape with small differences among species, in spite of its small difference the shape of an egg has been considered as an important factor to characterize species of birds. In this study the eggs of desi, exotic and quail showed similar ovalish conical shape with blunt and pointed ends (Fig 1). The shell weight (6.74 ±0.29) and shell thickness (0.48±0.01) were significantly higher in brown shell egg when compared to white shell and quail egg, which was showed in Table 1. The present results were supported by the results of Sing (2009) and Túmová (2011), which reported that the higher eggshell qualities were found significant in brown hybrids. This result was agreed to the results of Zita (2009) and Desalew et al., (2013) found that egg shell thickness depends on the effect of layer type, environmental conditions and feed quality. The specific gravity, surface area and SWUSA unit showed significantly (P<0.05) higher in brown shell eggs when compared to exotic and quail egg (Table 1). This result was agreed by Watkins et al., (1977), which observed that calcium particles with hen size particles of improved egg-shell strength.

**Qualitative analysis of eggs**
In qualitative analysis the shape index of brown eggs was higher when compared with the white and quail eggs, but the difference is non-significant. Albumen index and yolk index on quail egg were slightly increased in level of calculated value when compared to desi and exotic eggs (Fig 2). This result is in agreement with Premavalli and Viswanathan (2004), which reported that variation in shape index for indigenous and white leghorn chicken eggs as may be due to age of layers and system of management and genetic makeup of the breed. In addition to this, shell weight % and yolk weight % were significantly (P<0.05) higher in desi egg, when compared to other egg as well as albumen weight % of exotic egg was significantly (P<0.05) higher, when compared with desi and quail eggs (Fig 3). Garcia et al. (2005) and Sanglilamadan et al. (2013) found that quail dietary protein group did not have any significant effect on percent albumin and Yolk. The reason for poor quality shells as the bird ages is still not clearly understood.
Internal character of egg
The internal egg quality on quail egg were significantly (P<0.05) higher in Haugh unit % (83.89±0.52) when compared to desi and exotic chicken egg (81.68±11.28 and 77.78±13.28), respectively (Table 2). Sakunthaladevi and Reddy (2005) and Hussain et al. (2013) found a positive and significant difference between Haugh unit (HU) of different sources of eggs which was correlated with the present findings. The internal character of albumen-yolk length, width, thickness, and yolk color of quail egg had slightly lower, but their significantly (P<0.05) different than desi and exotic chicken eggs (Table 2 & 3). Cotterill et al. (1962) found that among the small eggs had a higher yolk portion than large eggs. But, it might be due to variation in stains, stocking density, seasonal factor, feed and the age of the birds (Saiful et al., 2010).

Quantitative analysis of egg
In quantitative analysis, yolk cholesterol level was extremely lower in quail egg (14.02±0.9) when compared to desi and exotic birds eggs (369.77±29.83 and 370.50±32.36), respectively. However, they are significantly (P<0.05) different followed by desi and exotic eggs (Table 4). The albumen crude protein level were significantly (P<0.05) higher in quail egg (11.98±0.58), when compared to desi and exotic birds egg (4.5±0.06 and 3.5±0.46), respectively (Table 4). Since hen’s eggs diet had a nutritional profile particular protein and fat contents. The yolk mass is related to the amount of cholesterol (Abdullahi et al., 2003; Sparks et al. 2006; Sangilimadan et al., 2013) and the eggs contain so many nutrients that help the body. Moreover, egg molecules represent a major source of active principles used by medical, pharmaceutical, cosmetic as well as biotechnological industries (Anton et al., 2006).

Conclusion
Qualitative and quantitative analyses of Japanese quail eggs showed significant reduction in level of egg yolk cholesterol. The research confirmed that quail eggs have higher level of Haugh unit and albumin protein compared to brown shell and white shell eggs. Thus, quail egg is good nutritional food and may be the alternative resolving problem for human health in developing countries and also may be a good potential solution for resolving problem for human health in developing countries and also may be a good potential solution for the world food problem. It is a necessary and commonsense component of any effective reform and sustainable food system by using this quail eggs.

References


