Comparative study of egg quality traits in local breeds and commercial lines of chickens

Ziaul Islam¹, Sarzamin Khan², Amin Ullah Jan³ *, Zia Ur Rahman Khalil¹, Fida Muhammad Khan¹, Muhammad Inam¹, Asad Sultan²

¹Department of Animal Sciences, Faculty of Sciences, Shaheed Benazir Bhutto University Sheringal Dir Upper, KPK, Pakistan
²Department of Poultry Science, Faculty of Animal Husbandry and Veterinary sciences, KPK Agricultural University, Peshawar, Pakistan
³Department of Biotechnology, Faculty of Sciences, Shaheed Benazir Bhutto University Sheringal Dir Upper, KPK, Pakistan
⁴Live Stock and Dairy Development Department, KPK, Pakistan

Key words: Rural eggs, Commercial eggs, Egg quality

http://dx.doi.org/10.12692/ijb/10.2.1-5 Article published on February 20, 2017

Abstract

Eggs are highly important food because of their high value of protein and richness of vitamins and minerals. Similarly to other types of food, eggs have become subject of discussions about food safety. Intensive production techniques, in which several chemical additives are used, are put into question by consumers. In this study, village eggs are compared with commercial eggs, which are produced under conditions of intensive agriculture in terms of egg quality characteristics. Rural eggs were collected from four different villages in District Dir Upper, while commercial eggs were collected from four different markets in same District. Significant difference was found in rural and commercial egg in egg quality parameters. Highest egg weight (52.3g) and albumen weight (33.71g) was noted for commercially produced eggs. Similarly, egg to albumin weight ratio was highest (64.40 g) for commercial eggs. Significantly, thicker shell (0.40 cm), higher egg yolk weight (15.47 g) and egg to yolk weight ratio (33.96 g) was recorded for rural eggs. Rural eggs had higher haugh unit (85.52) as compared to commercial eggs (84.71). It is concluded, that eggs produced in rural farming system had high nutritional value as compared to commercially produced eggs.

*Corresponding Author: Amin Ullah Jan aminjan@sbbu.edu.pk
Introduction

Hen’s eggs have been traditionally considered as an important source of nutrients for humans (Nau et al., 2003). Thanks to their low production cost, they represent a cheap source of animal proteins and lipids (Nys and Sauveur, 2004). Moreover, they are culturally accepted worldwide and are not submitted to any religious nor traditional interdiction.

Nowadays, it is widely recognized that eggs are more than a source of nutrients, numerous studies describing biological properties potentially exploitable by pharmaceutical, food-processing and cosmetic industries (Mine and Kovacs-Nolan, 2004). In the context of the growing demand for industrially processed egg products (Tixier-Boichard et al., 2006), egg dry matter efficiency, both in terms of yield and quality, is of substantial interest (Suk and Park, 2001).

The major constituent of albumen is water amounting to 88% of total weight. Its solid content is predominantly composed of proteins (11%). The total solid content of egg yolk is generally 50% and the major constituents of yolk are proteins (16%) and lipids (32%) (Ahn et al., 1997). The most important trait of egg composition, linked to egg dry matter, is the yolk: albumen ratio (Hartmann et al., 2003).

Beside the Y: A ratio, eggshell resistance to shocks is an economically primordial trait as it determines the ability of eggs to withstand transportation from producers to consumers (Mertens et al., 2006). Important losses, up to 10% of total egg production, can be attributed to eggshell fragility (Washburn, 1982). Moreover, an intact eggshell is also necessary to impede bacterial invasions of eggs and so to reduce food poisoning risks (Mertens et al., 2006).

Egg composition is not a uniform trait. Several factors affect it, such as breed, age, size or laying season (Coutts et al., 2006). In rural area, poultry eggs are mostly produced under traditional and non-intensive production system and play a key role in economic development of rural community (Kondombo et al., 2003).

Materials and methods

Experimental material

Two hundred eggs were randomly collected (one hundred eggs were collected from the rural area and one hundred were collected from the commercial form). All eggs were properly numbered and stored at 6°C till the day following collection.

Eggs measurement

Eggs measurements were started with weighing of eggs (accuracy 0.01 g). Then, length and width of eggs were measured by means of an electronic sliding calliper (accuracy 0.01 mm) to calculate egg shape index, defined as the ratio between length and width multiplied by 100. In an attempt not to distort results about eggshell strength and internal quality, all eggs were checked for cracks and cracked eggs were excluded from further measurements. Crack detection was done by means of the acoustic egg tester, a lab scale device which measures the acoustic response of an egg’s shell after a light impact with a rod using this information to determine whether an egg is cracked.

When an egg is intact, the same device can be used to define eggshell strength, expressed as the Dynamic stiffness (K_dyn) which is calculated by the following formula: $K_{\text{dyn}} = k * m * RF^2$, with $m$ as egg mass (kg), $k$ a constant and $RF$ the resonance frequency of the egg shell vibration in Hz. Next, the more classic egg shell breaking force ($F_{\text{max}}$) was determined using a universal tensile and compression test machine (UTS test system GmBH., Ulm, Germany). Eggs were placed horizontally between two steel plates compressing them at a speed of 10 mm/min. $F_{\text{max}}$ was the force at which egg breakage occurred.

Eggs quality

To define the internal egg quality, eggs were broken onto a flat surface. The height of the thick albumen was measured at its widest part at a position half way between the yolk and the outer margin using tripod micrometer.
**Haugh units**
Individual Haugh units (HU) were calculated from the height (H) of the albumen and egg weight (W) using the simplified HU formula (Silverides, 2004):

$$\text{HU} = 100 \log (H - 1.7 W^{0.37} + 7.57).$$

**Albumen weight**
The yolks were carefully separated from the albumen. The shell, including membranes and yolks were weighted separately (accuracy 0.01 g). Albumen weight was determined by subtracting yolk and shell weights from total egg weight. The shell thickness was measured at three different random points in the equatorial shell zone using an electronic micrometre (accuracy 0.01 mm). The calculated average was used as a trait.

**Statistical analysis**
Data were statistically analyzed using analysis of variance technique (10) in completely randomized design. Egg quality parameters were considered as dependent variables and farming system was considered as treatment variable. Posthoc analysis was computed to compare the means using Tukey procedure. Statistical package SAS (11) was used for statistical analysis. Significance was found at level of (p<0.05).

**Results**

**Egg weight and composition parameters:**

**Total egg weight**
Breed differences for egg weight and composition parameters was shown in (Table 1).

**Table 1.** Whole egg weight, shell weight (g; Mean ± SE) and shell thickness (mm) of commercial and rural eggs.

<table>
<thead>
<tr>
<th>Farming system</th>
<th>Characteristics</th>
<th>Commercial</th>
<th>Rural</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Egg weight</td>
<td>52.30±1.66</td>
<td>45.75±1.27</td>
<td>0.00</td>
</tr>
<tr>
<td></td>
<td>Shell weight</td>
<td>4.44±0.174</td>
<td>4.68±0.158</td>
<td>0.30</td>
</tr>
<tr>
<td></td>
<td>Shell thickness</td>
<td>0.36±0.85</td>
<td>0.40±0.01</td>
<td>0.01</td>
</tr>
</tbody>
</table>

Means with different superscripts within same row is significantly different at p<0.0.

Highly significant (p<0.05) differences were found in egg weight between rural and commercial breeds. The average egg weight of commercial (52.30 g) and rural eggs was(45.75 g).

**Eggshell weight**
Table (1) shows comparison of the egg shell of commercial and local breeds. These breeds show highly significant differences for the egg shell. The highest egg shell weight was noted for commercial (4.68 g) as compared to rural eggs (4.44 g).

**Eggshell thickness**
Highly significant differences were found for egg shell thickness in rural and commercial breeds (Table 1). The highest egg shell thickness was found in rural Eggs (0.40 mm) while (0.36 mm) in commercial eggs.

**Egg yolk weight**
The egg yolk weight comparison of the rural and commercial lines was shown in the (Table 2). Significant (p<0.05) differences were observed for egg yolk weight in the studied lines. The average yolk weight for commercial was (13.90 g), while (15.469 g) in rural breeds.

**Egg albumen weight**
Table (2) shows the significant differences in egg albumen weight between the commercial and rural lines. The highest (33.71g) egg albumen weight was recorded for commercial eggs as compared to rural eggs (25.91g).

**Ratio of albumen to egg weight**
The ratio of albumen to egg weight was shown in the (Table 2). The ratio of albumen to egg weight was noted significantly higher for commercial eggs as compared to rural eggs.
Table 2. Mean ± SE of internal egg quality parameters of commercial and rural eggs.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Commercial</th>
<th>Rural</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Yolk weight</td>
<td>13.91±0.73</td>
<td>15.46±0.40</td>
<td>0.00</td>
</tr>
<tr>
<td>Albumen weight</td>
<td>33.71±1.23</td>
<td>25.91±1.16</td>
<td>0.00</td>
</tr>
<tr>
<td>Yolk weight %</td>
<td>26.53±1.05</td>
<td>33.96±0.86</td>
<td>0.00</td>
</tr>
<tr>
<td>Albumen %</td>
<td>64.40±1.05</td>
<td>56.34±1.04</td>
<td>0.00</td>
</tr>
<tr>
<td>Shell weight %</td>
<td>9.05±0.36</td>
<td>9.84±0.51</td>
<td>0.22</td>
</tr>
<tr>
<td>Haugh unit</td>
<td>84.71±0.84</td>
<td>85.52±0.61</td>
<td>0.44</td>
</tr>
</tbody>
</table>

Means with different superscripts within same row was significantly different at p<0.05.

Haugh unit
Haugh's Units were measured in this study to ascertain freshness of the investigated eggs. Non-significant difference was observed for Haugh unit between commercial and rural eggs. The highest Haugh unit (85.52) was in rural eggs as compared to commercial eggs (84.71).

Discussion
Egg composition is not a uniform trait and depends on many factors such as the hen breed or age. As poultry being endangered worldwide provides a broad genetic diversity, there is an urgent need for assessment of egg quality in local breeds, which have already been proven to bear some economically advantageous traits. Highly significant differences were recorded between breeds in total egg weight, egg composition and mechanical resistance. In this respect, the tested local breeds showed very interesting characteristics. The present results, regarding whole egg weight, shell thickness and shell weight are in line with the findings of (Cicek and Kartalkanat, 2009; Yakubu et al 2008) who reported significant effect of farming system on external egg quality parameters. It is known that egg weight is affected by factors like genotype, age, nutrition, parental average body weight and other nutritional factors (Yakubu et al., 2002). It can be assumed that the lower weight of the rural egg in this study is due to the above factors. The shell is a structure that contains calcium, since calcium concentration is high in the fodder therefore free range birds consume sufficient quantity of calcium resulting high shell thickness for rural egg (Boltumelo, 2005).

It also attributes the fact that rural birds consume more calcium as compared to commercial chicken. Significant differences were observed for egg yolk and albumen weights. The results of the present study are an agreement with the findings of by (Wang, 2009; Hussein, 1993). Difference in internal egg quality may be due to different housing conditions, age, storage condition and feed scavenged by the chickens (Jones and Musgrove, 2005. Zaman, 2005).

In developing countries, rural poultry farming are of high importance in terms of maintenance for people living. It provides them not only with food but also at considerable amount offers the opportunity of economic support. In past the rural eggs were primarily consumed by the local people, but now a day’s people from other area tends to consumed these products. It is a known fact that rural products are of top rank probably due to high nutritive value for almost all age groups, an important iron source for children and a low caloric and easily digested nutrition for adults. Rural eggs were found with thicker egg shell, higher egg yolk weight and higher Haugh unit and can be considered as with high nutritional value as compared to commercially produced eggs (Silversides, 2004).

References


