RESEARCH ARTICLE

EFFECT OF STORAGE TEMPERATURE AND HOLDING PERIOD ON INTERNAL QUALITY OF CHICKEN EGG

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Abstract: The objective of this study was to evaluate the effects of storage temperature and holding period on internal quality of chicken eggs. A total of 108 fresh eggs were obtained from Vanaraja hens. Samples of 36 eggs each were stored in refrigerator (5°C) and at room temperature (40°C) for 5,10,15 days of holding period and 36 fresh eggs were evaluated for their internal characteristics within 2 hour of being laid. This study indicated that as the holding period increased egg weight, albumen height, yolk height, albumen index, yolk index and Haugh unit significantly ($p<0.01$) decreased. Albumen index egg quality indicator was significantly ($p<0.01$) decreased from 6.54% to 3.71% at 15 days of storage period. Storage temperature showed a significant difference ($P<0.01$) between eggs stored at room temperature with that stored in refrigeration (5°C). Refrigerated (5°C) eggs have higher albumen height (5.9 mm), yolk height (19.1 mm), albumen index (7.39 %), yolk index (43.9 %) and Haugh unit (84.6) than eggs stored at room temperature. The results suggest that eggs significantly deteriorate in their internal quality with increasing by the storage temperature and holding periods.

Keyword: Storage temperature, Holding period, Albumen index, Haugh unit

INTRODUCTION

Egg quality has been defined by Stadelman (1977) as the characteristics of an egg that affect its acceptability to the consumer's. Egg quality is the more important price contributing factor in table and hatching eggs. The internal quality of eggs starts to decline as soon as they are laid by hens. Albumen quality is not only an important indicator of egg freshness, it is also significant for the egg processing industry. Albumen quality is a standard measure of egg quality, and it is influenced by storage temperature and holding periods (Samlli et al., 2005). Silversides and Scott (2001) reported that quality measurements based on the albumen height of fresh eggs. The albumen height of eggs is at maximum when the eggs are laid and decreases with increasing storage time. Most of the changes in egg quality in terms of HU, albumen height, yolk height, albumen index, yolk index and moisture loss by evaporation through the cell pores and escape of CO_2 from albumen. Many studies have linked extended holding length with decreased egg quality (Jones and Musgroove 2005; Paditey, 2010). In this study freshly laid eggs were stored at different temperature to evaluate the effects of storage temperature and holding periods and their interaction on egg quality.

MATERIAL AND METHOD

Collection of samples: Eggs were collected from Vanaraja breed maintained under deep litter system in Government Poultry Farm, Durg. A total of 108 fresh eggs were obtained and measured for their internal quality. Fresh eggs comprising 36 in numbers were evaluated for their internal characteristics within 2 hour of being laid. Samples of 36 eggs each were stored in refrigerator (5°C) and at room temperature (40°C) for 5, 10,15 days of holding period. Twelve eggs from each treatment totaling 24 eggs were taken periodically at 5 days interval for a total duration of 15 days of holding period.

Egg quality analysis: The indicator of composition and qualities of eggs includes % egg weight loss, albumen height, yolk height, albumen index, yolk index and Haugh unit. The percentage (%) of weight loss of the whole egg was calculated as {[initial whole egg weight (g) at day 0 – whole egg weight (g) after storage]/initial whole egg weight (g) at day 0} × 100 (Bhale *et al*, 2003). The eggs were broken out followed by measurement of the maximum albumen height from at least 3 places with spherometer. Albumen index were calculated for individual egg using the following formula: Albumen Index (%) = Height of thick albumen (mm)/ Mean diameter of thick albumen (mm) x 100 (Heiman and Carver, 1936).The height of yolk was measured in the centre of the egg yolk. The yolk index was calculated after the measurement of height and diameter of yolk with the help of spherometer and vernier calipers, respectively (Funk, 1948). Haugh units were calculated from the recorded egg weights and albumen heights using the formula $HU= 100 \log_{10} (H-1.7 W^{0.37}+7.56)$, where HU= Haugh unit, H = height of the albumen (mm), and W = egg weight (g).

Statistical analysis: The data obtained from the study were statistically analyzed by two way classifications of Analysis of Variance to see the effect of storage temperature and holding period on internal quality of Chicken egg by using statistical

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program SPSS (2007). The individual means was tested by Duncan's Multiple Range Test modified by Kramer (1956) for their significance.

RESULT AND DISCUSSION

Egg weight, % egg weight loss, albumen height, yolk height: Table (1) revealed that the mean value of fresh egg weight was 57.4 g in Vanaraja chicken whereas ***e***gg weight was significantly decreased (P<0.01) at different holding periods. Table (2) indicated that the mean value of % egg weight loss at 5 day (0.05%), 10 days (0.79%) and 15 days (1.99%) was observed. These results are almost in agreement with those of Samli *et al.* (2005) and Jin *et al.* (2011) who reported weight reductions of 2.08 and 3.11% respectively with in 5 and 10 days of holding periods. The reason for loss in weight was presumably attributed to loss of humidity from inside the egg due to evaporation effect. Storage temperature has significant effect on the percent weight loss. Table no (2) indicated that the percent egg weight loss was higher in room temperature (2.5 %) than refrigerated eggs at (5°C). These findings are in close agreement with Tabidi (2011). Evaporation of water and to a much lesser extent, loss of CO2 from the albumen through the approximately 7500 pores of egg shell lead to an overall weight loss of whole egg (Obanu and Mpieri,1984). However, keeping eggs under refrigeration (5°C) reduces this moisture loss likewise this moisture loss reduction can be achieved by increasing the relative humidity of the storage room. Table (1) showed that the mean value of albumen height of fresh egg was 6.62 mm. Albumen height was significantly (p<0.01) decreased with increased in holding periods (Table 2). Results indicated that the mean value of albumen height was 5.26mm (5 days), 4.11mm (10 days) and 3.18mm (15 days) at different holding periods. The present findings corroborate with Scott and Silversides (2000), who reported a significant decrease from 9.16 - 4.75 mm in albumen height (p<0.005) in stored eggs at 10 days. Different storage temperature were found to have a significant difference (P<0.01) on the average albumen height (Table 3). Albumen height was found higher in refrigerated eggs (5.9mm) than eggs at room temperature (2.4mm). Various holding period and storage temperature were found a significant difference (P<0.01) on yolk height (Table 2 & 3). The results showed that there was higher yolk height (19.1mm) in refrigerated eggs than egg stored at room temperature (Table 3). The decrease in albumen and yolk height with increasing temperature observed in this study corroborates the findings of Scott and Silversides (2000) and Abanikannda (2007). The difference between the various temperatures to maintain egg quality could be due to their varying ability to retard carbon dioxide loss and breakdown of carbonic acid to carbon dioxide. This is because these losses cause mucin fibre which gives the albumen and yolks their gel-like texture to loss their structure and so the albumen and yolk becomes watery (Raji *et al*., 2009; Gavril and Usturoi, 2012).

Table 1. Mean value of internal quality of fresh eggs

Breed	Egg weight (g)	Egg weight loss (%)	Albumen height (mm)	Yolk height (mm)	Albumen index (%)	Yolk index (%)	Haugh unit
Vanaraja	57.4	0	6.62	18	8.76	40.4	89.5

Albumen index, yolk index, Haugh unit: The effect of holding periods and storage temperature on albumen index, yolk index and Haugh unit are shown in Table 2 and 3. The results showed that the holding period affected significantly the albumen index. The findings revealed that albumen index was significantly (p<0.01) decreased at 5 days (6.54%), 10days (4.97%) and 15 days (3.71%) of holding period (Table 2). These results are similar to the result of Tabidi (2011). Table no (1) indicated that albumen index of fresh eggs was 8.76%. Refrigerated eggs showed the higher albumen index (7.39%) and maintained their quality compare to the fresh egg whereas room temperature eggs has 2.58% albumen index with significant difference. The significant (P<0.01) decrease in yolk index was observed with increasing holding period. The present study (Table 2) showed that yolk index significantly (p<0.01) decreased from 36.7%-30.8% at 15 days of holding period. Table 2 indicated that refrigerated eggs showed the highest value of yolk index (43.9%) than room temperature egg (27.2%). The mean value of HU at 5, 10 and 15 days of holding period was 79.4, 71.9 and 63.7 respectively (Table 2). Haugh unit for the eggs stored in 5°C and 40°C were 84.6 and 56.9 respectively. These results are in agreement with Tona *et al.* (2004) and Jones and Musgrove (2005), who reported storage temperatures adversely affected Haugh units (p<0.001).

Table 2. Overall effect of holding period on internal quality of Vanaraja eggs

Treatment	Egg weight before storage (g)	Egg weight after storage (g)	Egg weight loss (%)	Albumen Height (mm)	Yolk height (mm)	Albumen index (%)	Yolk index (%)	Haugh unit
5 day	58.5±0.49	58.42±0.59^{a}	0.05±0.05^{c}	5.26±0.23^{a}	16.4±0.44^{a}	6.54±0.32^{a}	36.7±1.15^{a}	79.4±1.51^{a}
10 day	57±0.47	56.5±0.45^{b}	0.79±0.17^{b}	4.11±0.17^{b}	15.5±0.36^{a}	4.97±0.25^{b}	34.5±0.95^{a}	71.9±1.4^{b}
15 day	57.9±0.6	56.72±0.50^{b}	1.99±0.19^{a}	3.18±0.16^{c}	14.4±0.42^{b}	3.71±0.2^{c}	30.8±1.13^{b}	63.7±1.48^{c}
SIG	NS	*	**	**	**	**	**	**

Values (Mean±SE) with different superscripts in a row differ significantly *p<0.05, **p<0.01; NS= Non-significant

Table 3. Overall effect of storage temperature on internal quality of Vanaraja eggs

Temperature	Egg weight before storage (g)	Egg weight after storage (g)	Egg weight loss (%)	Albumen Height (mm)	Yolk height (mm)	Albumen index (%)	Yolk index (%)	Haugh unit
40°C	56.5±0.67	55.0±0.65$^{\mathbf{b}}$	2.5±0.3$^{\mathbf{a}}$	2.4±0.16$^{\mathbf{b}}$	12.7±0.4$^{\mathbf{b}}$	2.58±0.4$^{\mathbf{b}}$	27.2±1.0$^{\mathbf{b}}$	56.9±1.6$^{\mathbf{b}}$
5°C	58.2±0.58	57.8±0.57^{a}	0.61±0.15$^{\mathbf{b}}$	5.9±0.2$^{\mathbf{a}}$	19.1±0.22$^{\mathbf{a}}$	7.39±0.32$^{\mathbf{a}}$	43.9±0.54$^{\mathbf{a}}$	84.6±1.21$^{\mathbf{a}}$
SIG.	**NS**	**	**	**	**	**	**	**

Values (Mean±SE) with different superscripts in a row differ significantly *p<0.05, **p<0.01; NS= Non-significant

From the results of the present study, it is concluded that egg weight, albumen and yolk height, albumen index, yolk index, Haugh unit, decrease with increase in holding period. Whereas % egg weight loss was increased with increase in holding period. It can also be concluded that quality of an egg is affected by storage temperature. Refrigerated eggs have shown better quality comparable to the fresh eggs than eggs stored at room temperature. Eggs kept at high temperature without any treatment were deteriorated in quality very fast and were not fit for consumption after one week.

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