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Evaluation of Egg Quality Traits in the Wholesale Market in Sri Lanka during the Storage Period

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ABSTRACT

The objective of this study was to assess the external and internal quality traits of eggs in wholesale egg market in Colombo, Sri Lanka and the effect of storage period in egg quality traits in the same market after receiving the eggs. First, a total of 482 fresh eggs were randomly collected from the above market and external egg quality traits were determined and recorded according to the definitions given in the Specification for Chicken Egg SLS 959:1992. After that, a total of 288 fresh eggs were randomly collected and various external and internal egg quality traits were measured and recorded according to the standard procedures over a storage period of 1, 3 and 5 d after receiving the fresh eggs to the wholesale market. Information about the shops was also collected using a pretested questionnaire. Using the recorded data, shape index, Haugh unit, albumen index and yolk index were calculated for each egg. Average weight, width, length and shape index of the eggs in the sample was 59.96 g, 4.33 cm, 5.78 cm and 75.03, respectively. Average shape index value was much closer to the standard value of 74. From the total sample 80.5% eggs had a normal and sound shape. However only 60.37% of the eggs are in the desirable quality range specified in SLS 959:1992, when the overall shell quality of the sample is considered based on shell cleanliness, defects and shape. The results of the current study indicated that eggs had significant ($p<0.05$) deterioration of all internal quality parameters tested with increasing storage time. However the effect was not significant ($p>0.05$) between the storage periods of 3 and 5 d after receiving eggs except for yolk color and yolk height. Desirable category of eggs had reduced and rejections had increased with the storage period. Main problems associated with the particular market were less space availability, higher percentages of dirty eggs, unavailability of proper packaging materials, no standard packaging system for eggs, and not implementing a standard grading system for eggs. Therefore the results of this study suggest that proper egg handling and storage conditions such as low temperature storage may be implemented to increase the proportion of desirable quality eggs in the above market.

(**Key words :** Egg quality, Wholesale market, Storage period, Sri Lanka, Haugh unit, Yolk index)

INTRODUCTION

The egg is a biological entity used in nature for the reproduction of the chicken. It protects the developing chick embryo, provides it a complete diet, and serves as the principal source of nutrition for the first few days of the chick's life (USDA, 2000). With the domestication of poultry, eggs became a popular source of food. Even today they play a vital role in many diets as a major source of essential nutrients (Watkins, 2002). The egg is an excellent source of high-quality protein with a high biological value and of certain vitamins and minerals (Lakhotia, 2003). Further the egg's protein content is complete as it contains all of the essential amino acids in well-balanced proportions.

The egg industry of the world is primarily based on chicken eggs. Eggs are one of the few foods used throughout the world and this character makes the egg industry an important section of the world food industry (Stadelman, 2002a). However, the egg production depends on various factors such as age of the bird, season, broodiness, moulting etc (Das, 2006). Global egg production has been exploding in recent decades, tripling since 1970 (Clark, 2007). The current level of global production is about 1,182 billion eggs per year from 6.4 billion laying hens. Moreover, 72% growth was recorded from 1990 to 2008due to the vast rise reported in Asia (Best, 2011). In a comparison between developing and developed nations in egg production, Clark (2007) mentioned that the former nations surpassed later in the 1990s and now have a 67.7% share in global production mainly due to the significant growth occurred in China,

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India, and Mexico.

Being a small island, Sri Lanka however could only occupy the 66th place in world egg production in 2009 having 1.14 billion eggs (64,760 tons) (Best, 2011). The national chicken population was about 14 million birds with highest population recorded in Kurunegala district followed by Gampaha, Puttalam and Colombo respectively in 2010. Average monthly production of the country was close to 95 million eggs in the same year which was approximately a 32% increase compared to 2005 (Department of Census and Statistics, 2009a; 2009b). The wholesale egg market in Colombo generally receives chicken eggs with different quality parameters from different regions of the country mainly from the North Western province. Although this market comprises of only a few shops, they solely determine the price of the egg. The egg marketing channel in the country is traditional compared to broiler marketing channel because of the continuous growth of semi-urban and rural egg sectors instead of an integrated system. Although grading and packaging of eggs is practiced in developed countries, majority of eggs are still sold without grading and packaging within the country (Iddamalgoda et al., 1998).

Egg quality has been defined as the characteristics of an egg that affect its acceptability to the consumers and is the more important price contributing factor in table and hatching eggs (Parmar et al., 2006). The total number of good quality eggs produced and some other practices such as packaging, transportation and storage of produced eggs are therefore vital in achieving the economic success in poultry farming (Niranjan et al., 2008). It is generally agreed that all characteristics of egg quality have a genetic basis and quality of chicken eggs may also vary due to several other factors like breed, strain, variety, rearing practices, temperature, relative humidity and season (Parmar et al., 2006 and Niranjan et al., 2008). Quality factors for eggs may be divided into two general groups as external and internal. Evaluation of these external and internal qualities of chicken eggs is important because of consumer preferences for better quality eggs. However such a study has not been conducted and published about the above egg market so far. Based on these internal and external quality parameters, the Sri Lanka Standard Institute have formulated the "Specifications for chicken egg SLS 959:1992" to be used within the country. Therefore the present study was aimed at assessing the external and internal quality traits of eggs in wholesale market in Colombo, Sri Lanka and the effect of storage period on egg quality traits in the same market after receiving the eggs.

MATERIALS AND METHODS

1. Measurement of external quality traits of eggs

A total of 482 fresh eggs were randomly collected from four main shops in the wholesale egg market, Colombo, Sri Lanka and various external egg quality traits were studied. The weight of each egg was measured using an electronic balance (KB- 2000, Hanna Instrument Co. Ltd., Korea) and the length and width of the eggs were measured using a vernier caliper (Gansu Henglong Industrial Products Co., Ltd., China). The shell color, shape, cleanliness and external defects of the egg were recorded according to the definitions given in Specification for Chicken Egg SLS 959:1992 (SLSI, 1992).

2. Measuring internal quality traits of eggs

A total of 288 fresh eggs were randomly collected from the same shops (72 eggs from each shop) and various external and internal egg quality traits were studied under the same storage temperature (i.e. room temperature of 30℃) over a storage period of 1, 3 and 5 d. Twenty four eggs from each shop for each day (total of 96 eggs per day) were tested. After measuring the external quality traits, the eggs were broken and the internal traits, including height of thick albumen, diameter of thick albumen, yolk height, yolk diameter and yolk color, were measured according to the standard procedures (SLSI, 1992). Information about the shops was also collected using a questionnaire which was modified and finalized after pre-testing.

In detail, the micrometer/spheremeter (S-6428, B.C. Ames Company, USA) was set on the glass surface. Then the zero reading was checked and adjusted by lowering the measuring rod until the point touched the surface of the glass on which the broken out egg will be placed. The point was retracted upwards to its full extent. The egg was weighted first and then broken on to the flat glass surface. The above micrometer was placed over the egg and the point was lowered until just touched the albumen. The albumen height that was indicated on the dial was recorded. The measuring rod was raised and cleaned. The micrometer was again placed over the egg and the point was lowered until just touched the yolk. The yolk height that was indicated on the dial was also recorded. The diameters of thick albumen and yolk were measured using the vernier caliper. Three readings were recorded for each of these traits and the average values were calculated. The color of the egg yolk was determined using a yolk color fan having tabs from 1 to 15 (1155, Roche & Company Ltd., Switzerland). Finally the broken-out egg was removed from the glass surface into a container. The procedure was repeated for the next egg. The measuring rod and the glass surface were cleaned before taking readings of the next egg.

3. Calculations

Using the recorded data, shape index, Haugh unit, albumen index and yolk index were calculated for each egg using the following formulae (Stadelman, 2002b; Monira et al., 2003; Parmer et al., 2006).

$$\text{Shape index} = \frac{\text{Width of egg}}{\text{Length of egg}} \times 100$$

$$\text{Haugh Units} = 100 \log\left[H - \frac{(\sqrt{G}\,(30W^{0.37} - 100)}{100} + 1.9\right]$$

Where H is the albumen height (mm), G is 32.2, and W is the weight of egg (g)

$$\text{Albumen index} = \frac{\text{Height of the thick albumen}}{\text{Diameter of the thick albumen}}$$

$$\text{Yolk index} = \frac{\text{Height of the yolk}}{\text{Diameter of the yolk}} \times 100$$

4. Statistical analysis

The data were analyzed using the statistical software MINITAB- Release 14.1 and Microsoft Excel 2007. The effect of storage period on internal egg quality traits was performed by one-way analysis of variance (ANOVA). When significant differences were detected, the differences among the individual mean values were identified by Duncan's multiple range tests using MINITAB- Release 14.1 software at a confidence level of $p<0.05$.

RESULTS AND DISCUSSION

1. External quality traits

Mean values of weight, width, length and shape index of eggs recorded in different shops and overall egg market are given in Table 1.

Weight of the eggs in the sample ranged from 41.14 g to 80.99 g having a mean value of 59.96 g (Table 1). Further, 51.04% eggs had an egg weight above the average value and 48.96% eggs had it below the average. Closer mean egg weights (60.23 g) were reported by Mathivanan and Selvaraj (2003) in White Leghorn layers.

According to the grades of eggs specified in SLS 959:1992 (SLSI, 1992), 51% of the total sample belonged to extra-large grade followed by large (35%) and medium (12%). Only 2% of the total eggs represented the small grade. When the results were compared with the grades/weight classes of eggs specified in India (Lakhotia, 2003), same results were observed because the weight classification for shell eggs in Sri Lanka is similar to that of India. However the result was different when U.S. weight classification for shell eggs was applied (Stadelman, 2002b) where the highest percentage (43%) of eggs was reported in large grade followed by extra-large and medium grades having 21% each. According to the study, extra-large and large eggs were therefore prominent in the wholesale egg market. Small graded eggs were found only in one shop during this study. Average egg weights of small, medium, large and extra-large grades are shown in Table 2.

Table 1. Mean values of some external quality traits

Name of the shop	Weight (g)	Width (cm)	Length (cm)	Shape index
Shop 01 (124)*	61.66 ± 4.88	4.36 ± 0.13	5.79 ± 0.23	75.34 ± 3.25
Shop 02 (125)*	58.87 ± 4.48	4.30 ± 0.17	5.66 ± 0.21	75.97 ± 3.44
Shop 03 (123)*	56.22 ± 7.64	4.20 ± 0.22	5.70 ± 0.32	73.89 ± 3.54
Shop 04 (110)*	63.07 ± 8.72	4.48 ± 0.36	5.99 ± 0.50	74.89 ± 3.76
Overall market (482)*	59.96 ± 7.12	4.33 ± 0.25	5.78 ± 0.35	75.03 ± 3.57

* Numbers within brackets indicate the number of eggs tested at the particular place.

Table 2. Mean weight, width, length and shape index of eggs found in each grade

Egg grade	Weight (g)	Width (cm)	Length (cm)	Shape index
Small (10)*	42.92 ± 1.26	3.92 ± 0.09	5.17 ± 0.24	75.98 ± 4.09
Medium (59)*	49.10 ± 2.29	4.02 ± 0.16	5.44 ± 0.20	74.07 ± 4.13
Large (167)*	57.03 ± 1.96	4.25 ± 0.11	5.64 ± 0.17	75.40 ± 3.10
Extra large (246)*	65.24 ± 4.65	4.47 ± 0.24	5.97 ± 0.34	74.97 ± 3.66
Total sample (482)*	59.96 ± 7.12	4.33 ± 0.25	5.78 ± 0.35	75.03 ± 3.57

* Numbers within brackets indicate the number of eggs under each category.

Table 1 shows that meanwidth and length of the eggs were 4.33 cm and 5.78 cm respectively. Width of eggs ranged from 3.18 cm to 5.57 cm whereas length of eggs varied from 5.00 cm to 7.39 cm (Data not shown). Mean width and length of eggs that belong to different grades are given in Table 2.

The mean shape index of the eggs in the total sample was 75.03. It was much closer to the shape index of a standard egg which is normally recorded as 74 (Li-Chan et al., 2002). However, only 10.37% of eggs had the shape index value of 74. The minimum and maximum shape indices were recorded as 60.77 and 95.05 respectively (Data not shown). However, much closer mean shape indices to the standard shape index value of 74 were found in all four shops as well as in all egg grades (Tables 1 and 2). In addition, 50.41% of total eggs had a shape index below the mean and 49.59% had it over the mean. Li-Chan et al. (2002) recorded shape index values ranging from 63.1 to 81.7 for eggs from a flock of Leghorn hens. Lower mean shape index values had been reported for White Leghorn layers (72.52) by Sakunthaladevi and Reddy (2004) and for indigenous Kadaknath breed (73.95) by Parmer et al. (2006). Chatterjee et al. (2006) observed higher mean shape index value of 80.76 for IWK and lower indices for IWI (73.77) and IWH (72.67) strains of White Leghorn.

A normal and sound shape as specified in SLS 959:1992 (SLSI, 1992) was present in 80.5% of total eggs. They had normal shape and unbroken shells free of pronounced thin spots, ridges or rough areas whereas the rest had abnormal shape (Fig. 1). Abnormal shape of these eggs was due to two main reasons namely misshapen (60.64%) and uneven calcium deposition (39.36%). Therefore 80.5% of the total eggs were in the desirable quality range specified in SLS 959:1992 (SLSI, 1992) according to the shape and soundness of the egg shell.

The prominent shell color was brown (70.33%) followed by white (26.76%). In the wholesale market tinted color eggs were rare (2.90%). However, Best (2011) reported that ratio between white and brown eggs in the world market remains approximately 50:50.

Fig. 1. Normal and abnormal egg percentage in wholesale egg market in Colombo, Sri Lanka.

No defects were found in 78.63% of the total eggs. According to the specification of chicken eggs given in SLS 959 (SLSI, 1992), 5.19% of eggs were checked eggs. Leaker and smashed eggs were not present in the sample. Uneven calcium depositions could be seen in 16.18% eggs (Fig. 2). Therefore 78.63% of the total sample was in the desirable quality range specified in SLS 959:1992 (SLSI, 1992) as they were unbroken.

Out of the total eggs, 36.31% eggs were in clean category followed by 32.16% of slightly stained eggs and 11.83% of moderately stained eggs (Fig. 3). According to data, 80.30% of the eggs were therefore in the desirable quality range specified in SLS 959:1992 (SLSI, 1992) as they were not in dirty category.

Only 60.37% of the eggs were in the desirable quality range specified in SLS 959:1992 (SLSI, 1992) when the overall shell quality of the sample was considered based on shell cleanliness, defects and shape. The rest 39.63% eggs

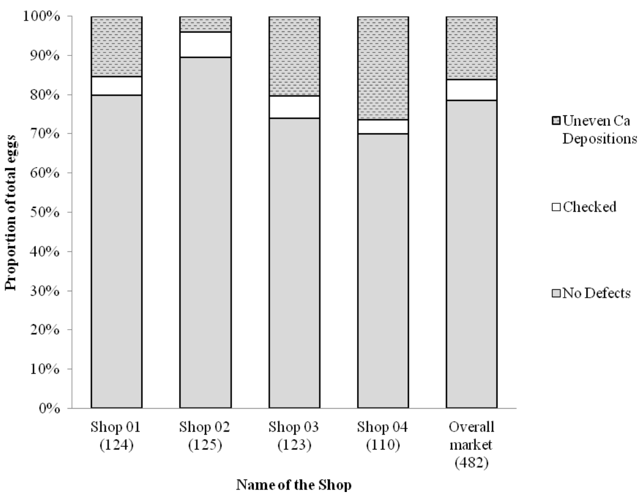

Fig. 2. Percentage of egg defects in wholesale egg market in Colombo, Sri Lanka.

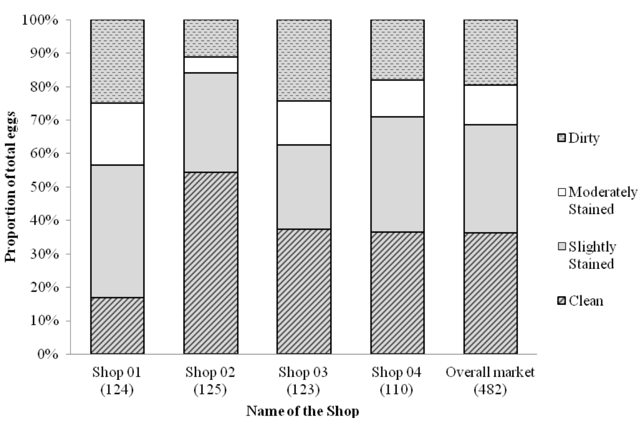

Fig. 3. Cleanliness of eggs in wholesale egg market in Colombo, Sri Lanka.

did not meetthe overall shell quality expected by SLSI. In SLS 959:1992, there are no further grades as those present in Indian and USDA classification of chicken eggs. According to the specifications given in the United States (USDA, 2000), 24.69% of the eggs tested belonged to grade AA and A and 40.46% to grade B making a total of 65.15% eggs with accepted shell quality. Only broken and dirty eggs (34.85%), were not in the acceptable range according to USDA classification of shell quality.

2. Internal quality traits during storage at 30℃

Mean values for various internal egg quality traits over the storage period are presented in Table 3. The shell thickness ranged from 0.30 to 0.40 mm with an overall mean value of 0.32 mm in the present study. Niranjan et al. (2008) reported similar shell thickness (0.32 mm) for Vanaraja poultry breed. Much closer shell thicknesses (0.31 mm) were observed among Kadaknath (Parmar et al., 2006), Naked neck and White Leghorn (Padhi et al., 1998). Slightly higher (0.33 mm) shell thickness was found in Nicobari indigenous fowl (Padhi et al., 1998).

Mean Haugh unit values significantly decreased ($p<0.05$) with the storage period at 30℃ (Table 3). One day after receiving eggs, wide range of Haugh unit values was found in this sample starting from 42.41 to 76.20. According to Fayeye et al. (2005) high quality eggs generally have a Haugh unit of 70 or above. One day after receiving eggs to the wholesale market, 60.41% of total eggs showed the Haugh unit value above 70. The most widely used measurement of albumen quality is the Haugh unit, proposed by Raymond Haugh in 1937. The higher the Haugh value, the better the albumen quality of the egg (Stadelman, 2002b). Therefore the albumen quality of eggs decreased significantly over the storage period after receiving to the wholesale market. However the decrease in mean Haugh unit values and therefore in the albumen quality of eggs was not significant between 3 and 5 d after receiving eggs to the market. These findings are in agreement with those of Jin et al. (2011) who observed a dramatic reduction in Haugh unit as storage time increased where the values decreased from 91.3 to 72.63 at 21℃ and from 87.62 to 60.92 at 29℃ during 10 days of storage. Similar results were also demonstrated by some other researchers (Tona et al., 2004; Samli et al., 2005; Akyurek and Okur, 2009) who reported that storage time and temperature adversely affected Haugh unit. Elena et al. (2006) also showed that Haugh unit decreased as storage time increased at 20℃. Sakunthaladevi and Reddy (2005) reported Haugh unit of 73 and 74 in White Leghorn and crossbreed chicken which were higher than those of the present study. For an indigenous poultry breed (Kadaknath) this value ranged from 62.58 to 81.96 with a mean value of 73.77 (Parmar et al., 2006). In a study which used chicken varieties developed for backyard poultry farming in India, Haugh unit values from 74.64 to 79.42 had been recorded (Niranjan et al., 2008). Further Padhi et al. (1998) has reported Haugh unit of 75.15 and 73.16 in Nicobari and Naked Neck local breeds of poultry. Chatterjee et al. (2006) reported lower Haugh unit values, 59.62 to 71.62 for White Leghorn strains. No proper egg grading and egg quality determination procedures are conducted at the wholesale market at the time of receiving egg. Therefore this

Table 3. Internal egg quality traits during storage period at 30℃

Egg quality trait	No. of days after receiving eggs to wholesale market[1)]		
	1	3	5
Haugh unit	67.03 ± 8.34^{a}	48.92 ± 12.27^{b}	43.20 ± 16.72^{b}
Albumen index	5.80 ± 1.38^{a}	3.31 ± 1.18^{b}	2.81 ± 1.29b
Yolk index	36.42 ± 2.09^{a}	31.29 ± 3.35^{b}	30.13 ± 3.15^{b}
Yolk color	3.40 ± 1.35^{a}	3.31 ± 1.55^{a}	3.17 ± 0.81^{b}
Albumen height (mm)	4.93 ± 0.79^{a}	3.34 ± 0.82^{b}	2.94 ± 0.90^{b}
Albumen diameter (mm)	87.53 ± 12.26^{a}	105.64 ± 16.93^{b}	112.15 ± 19.06^{b}
Yolk height (mm)	15.47 ± 0.81^{a}	13.72 ± 1.22^{b}	13.11 ± 0.99^{b}
Yolk diameter (mm)	42.52 ± 1.62^{a}	43.70 ± 2.72^{a}	43.96 ± 2.07^{a}

$^{a\text{-}c}$ Means with different superscripts within a row differ significantly ($p<0.05$)

[1)] Eggs from each shop (n=24) for each day (total of 96 eggs for each day).

market generally receives chicken eggs with different quality parameters from different regions of the country. There may be several strains ofbirds that provide eggs to the wholesale market which can have some genetic effect on internal qualities including Haugh unit. Even older eggs may be sent together with the fresh ones to the shops. These practices can lead to a lower Haugh unit even at 1st day after receiving eggs to wholesale market in Colombo. Jo et al. (2011) reported that the combination of chitosan coating and dry ice limited the moisture loss, CO_2 emission, and pH increase, which helped maintaining the freshness (Haugh unit) of eggs.

One day after receiving eggs, albumen index values ranged from 2.72 to 7.44 (Data not shown). A significant decrease ($p<0.05$) in mean albumen index values was observed with the storage period at 30℃ (Table 3). However the decrease was not significant between 3 and 5 d after receiving eggs to the market. Parmar et al. (2006) reported albumen index values ranging from 4.46 to 8.98 with a mean value of 7.03 for the indigenous poultry breed, Kadaknath.

The spherical nature of egg yolk can be expressed as yolk index, originated by Sharp and Powell in 1930 (Stadelman, 2002b). Therefore the strength of vitelline membrane can be assessed by yolk index (Li-Chan et al., 2002). Mean yolk index values also significantly decreased ($p<0.05$) with the storage period at 30℃ (Table 3). The present study showed that yolk index values ranged between 27.41 and 39.35 with a mean value of 36.42 after 1 d of storage period. Yolk index values had changed between 35.07 and 38.10 with a mean value of 37.07 for the indigenous Kadaknath poultry breed in a study conducted by Parmer et al. (2006). The results of the present study recorded after 1d of storage period were much closer to these values. In addition, chicken varieties developed for backyard poultry farming in India had given yolk index values ranging from 44.00 to 46.00 (Niranjan et al., 2008). Further Padhi et al. (1998) observed yolk indices ranging from 41.00 to 45.00 in Nicobari varieties.

Mean yolk color values reported after 1, 3 and 5 d of receiving eggs to market was 3.40, 3.31 and 3.17 respectively (Table 3). Therefore it can be suggested that the egg yolks were pale in color in the total sample. A significant decrease ($p<0.05$) in yolk color was also found between 3 and 5 d after receiving eggs to the market (Table 3). The highest and lowest values recorded were 8.00 and 1.00 respectively. These results are in agreement with those of Jin et al. (2011) who found that significant changes in yolk color occurred even after two days of storage depending on the storage temperature and time. Elena et al. (2006) reported that there was an average reduction from 9.91 to 8.33 in yolk color at 30 d of storage at 20℃ and no color difference at 4℃. It has been found that the protein structures of the thick albumen and vitelline membrane breakdown faster with the increasing internal temperature of an egg. This will allow water to enter the yolk causing dilution of the pigment. Albumen proteins may also enter the yolk decreasing the yolk color with the prolonged storage time. This may partly explain the negative effect of storage and time on the yolk color (Jones, 2006; Jin et al., 2011).

Albumen and yolk heights significantly decreased ($p<0.05$) over the storage period at 30℃ (Table 3). Yolk height is one of the two egg quality traits that showed a significant decrease at 3 d after receiving eggs. These also expressed the fact that the albumen and yolk qualities of eggs in the wholesale market significantly ($p<0.05$) decreased over the storage period at 30℃. These results are in agreement with the findings of Elena et al. (2006), who showed that albumen height decreased as storage time increased at 20℃.

With the exception of egg yolk color, all the internal egg quality traits were significantly ($p<0.05$) influenced by the storage period at 30°C between 1 and 3 d after receiving eggs to wholesale egg market. However, the effect was not significant ($p>0.05$) between the storage periods of 3 and 5 d after receiving eggs other than for yolk color and yolk height (Table 3). One day after receiving eggs to wholesale market, 33% of the eggs were in the desirable range whereas 67% were in the maximum tolerance category (Fig. 4) according to SLS 959 where 3 specific categories have been defined based on albumen quality. Desirable category had reduced and rejections had increased with the storage period. Five days after receiving eggs, none of the eggs were found in desirable category. However 65% of them were in the maximum tolerant category.

In a comparison using U.S. standard, percentage of AA quality eggs had reduced with the storage period from 33% in 1 d after receiving eggs to 0% in 5 d after receiving eggs (Fig. 5). However according to this standard, there were no rejections because they have an egg grade called "grade B". Eggs rejected under SLS standards belonged to this category according to U.S. standards.

3. Present status of wholesale egg market

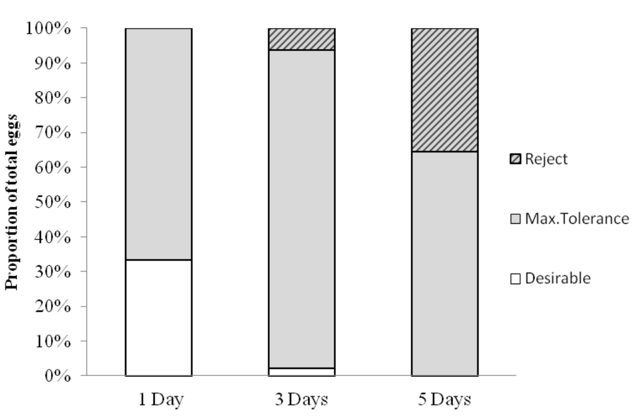

Fig. 4. Percentage of eggs belonged to different quality categories over the storage period according to SLS 959 specifications.

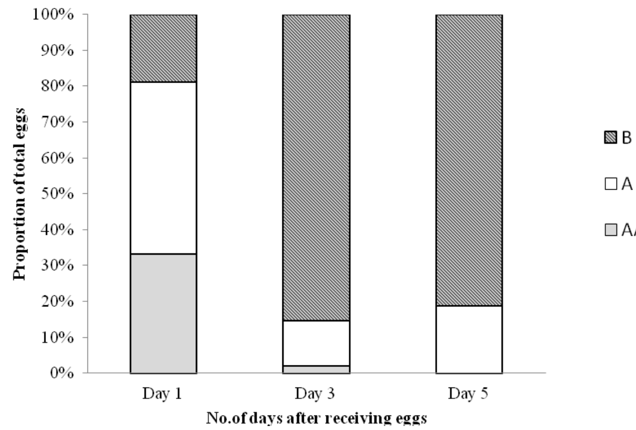

Fig. 5. Percentage of eggs belonged to different grades over the storage period according to U.S. specifications.

All shops interviewed had stored their eggs at ambient temperature (30°C). However, sufficient ventilation existed in each shop and rodents and insects were not present in shops. However, the cleanliness of the shops was not satisfactory. Wooden boxes were used as the main packaging container. It was reported that almost all boxes were either clean or moderately clean and free of fungus. No inner packaging as specified in SLS 959:1992 was used. Paddy straw had been used as a bedding material to reduce the damages during egg packaging and transportation. Eggs were packed in horizontal direction between layers of straw. All shops have used clean and dry straw that are free of fungus and dust. Though handling instructions were not given, workers normally practiced smooth handling. According to the information gathered 1to 3% of the total eggs generally breaks during transportation and handling, which were removed just after receiving from the bulk. Eggs are only graded according to size (large and small) and color (white and brown). Price of a brown color egg is always higher than that of a white color egg by Sri Lankan Rs. 0.50. According to the wholesalers, the main problems associated with the current market are less space availability, higher percentages of dirty eggs, unavailability of proper packaging materials and lack of standard packaging and grading system for eggs.

CONCLUSION

From the total sample collected from wholesale egg market in Colombo, Sri Lanka, 80.5% eggs had a normal and sound shape as specified in SLS 959:1992. Only 60.37%

of the eggs are in the desirable quality range specified in SLS 959:1992 when the overall shell quality of the sample is considered based on shell cleanliness, defects and shape. All internal egg quality traits discussed were significantly ($p<0.05$) influenced by the storage period at 30℃ after receiving eggs to wholesale egg market. According to the wholesalers, the main problems associated with the particular market are less space availability, higher percentages of dirty eggs, unavailability of proper packaging materials, no standard packaging system for eggs, not implementing a standard grading system for eggs. Therefore the results of this study suggest that proper egg handling and storage conditions such as low temperature storage may be implemented to increase the proportion of desirable quality eggs in the above market.

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