Is the Information on the Egg Label Claimed by Egg Producer True?

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Abstract

As the egg consumers, it would be of interest if the information on the label claimed by the egg producer is true and safe food to consume. Information on the label of egg packaging has always been argued by consumers because some of them believe that the information stated on the label mislead. This study aims to validate the information on the label of the egg packaging claimed by the egg producer based on the best before date (BBD) with egg quality to help consumers to consume a quality and safe product. A study had been carried out where two egg grades, B and C were used as replicates. The weight of eggs was measured and divided into two groups. Then, they were subjected to storage at room (RT: 24ºC to 26ºC) and refrigerator temperature (FT: 1ºC to 10ºC) from the day bought until reached the best before date. Results were analysed using t-test and ANOVA using SAS software. The result proposed that the mean egg weight exceed the egg weight stated on the label of the packaging. There was a significant difference ($p<0.05$) on egg weight, Haugh unit, specific gravity, yolk width, yolk weight (%) and albumen weight (%). In contrast, there was no significant difference ($p>0.05$) for shape index, yolk colour, shell weight (%) and shell thickness. Egg stored in refrigerator temperature showed better quality until best before date than the egg in room temperature. Therefore, this study highlights the importance of information on the egg label and for consumers to choose an egg with the longest best before date. The low temperature of storage also needs to take into account to maintain the egg quality.

Keywords: Egg quality, storage temperature, best date before.

Introduction

In Malaysia, the per capita consumption of eggs is estimated at 322.7 and 413.2 eggs for the years 2019 and 2020, respectively. Since an egg is rich in nutrients, provides readily available, easy to access and complete food for people of all levels of ages. It is also considered a cheap source of protein and at the same time, the egg characteristics are delicate and perishable (Layman and Rodriguez, 2009). It is more likely to decay and go bad quickly if it is not handled properly. However, almost all the eggs in the markets were managed well and in a good condition. The eggs are packed in suitable packaging materials which is paper pulp carton and plastic carton to maintain the quality (Zeidler, 2002). Apart from that, the producer provides information that is printed on the packaging or printed on the egg, such as grade, size, weight, batch number and best before date. Unfortunately, not all types of eggs in the market have information on its packaging. These are important information for consumers to ensure they choose fresh and the best eggs. Nevertheless, the truth of the information provided by the producer is still in debate. It would be of interest if the information on the label claimed by the egg producer is true. Information on the label of egg packaging has always been argued by consumers because some of them believe that the information stated on the label is misleading. For example, the weight of the egg does not reach the minimum standard weight labelled. Other than that, the eggs are also more likely to get spoiled before the best before date. This study aims to validate the information on the label of the egg packaging claimed by the egg producer based on the BBD with egg quality to help consumers to consume a quality and safe product.

Materials and Methods

Samples and data collection

A total of 144 eggs of each labelled as grade B (n=72) and C (n=72), newly arrived four weeks before the best before date (BBD) were purchased from the same hypermarket brand in three batches. The eggs were randomly selected among grades B or C and stored at either the room temperature (RT: 24ºC to 26ºC) or refrigerator temperature (FT: 1ºC to 10ºC). The egg weight, shape index and other external egg quality for all eggs were recorded. A total of nine eggs from each storage temperature & grade were selected at random and various egg quality parameters (shape index, weight, Haugh unit, yolk colour, were recorded at day 21, 14, 7, and 0-day BBD. All eggs were weighed using an electronic balance (Mettler Toledo). The shape index was calculated based on the width and length of the egg measured using a Vernier calliper and calculated using a formula as follow:

$$\text{Shape Index} = \frac{Width\ of\ egg\ (mm)}{Length\ of\ egg\ (mm)} \times 100$$

The shapes index of eggs is categorised as sharp (<72mm), standard (72 – 76mm) and round (>76mm). The shell of the eggs is allowed to dry overnight at room temperature before weighing. The shell thickness was the last step for this study and it was measured using a micrometre gauge. Three-point of shell thickness which is sharp, middle and blunt of the egg were taken. Then, the average of these measurements was used as a shell thickness reading.

Specific gravity, a total of nine salt solutions with different levels of specific gravity from 1.060 to 1.100 were prepared and used to measure the specific gravity of eggs. The differences between each level are 0.005. The specific gravity of the salt solution was checked using a hydrometer before measuring the specific gravity of the eggs. The eggs were dipped into every salt solution for a few seconds and the specific gravity will determine when the egg floats.

The internal egg quality was measured using EggAnalyzer®, ORKA Food Technology, which measures egg weight, albumen height and yolk colour without touching the egg and automatically calculates Haugh units. Haugh Unit measures the thickness of the albumen and compared to the weight of the egg as shown in the formula below:

$$\text{Haugh Unit} = 100 \log (H + 7.57 - 1.7\, W^{0.37})$$

H = Albumen height (mm)
W = Egg weight (g)

The weight of albumen was calculated by subtracting the weight of egg yolk and shell from the total egg weight. Then the percentage of yolk was calculated from the albumen and shell for egg proportion.

Data Analysis

All parameters measured from this experiment were recorded in Microsoft Excel. The actual egg weight was compared with the weight stated on the label. The mean of the egg between grades B and C were compared by using the Student's t-test and the effect of storage time and temperature on eggs was analysed by using two-way Analysis of Variance (ANOVA) with Statistical Analysis System (SAS) software. Next, Duncan's Multiple Range Test (DMRT) was used to measure the differences across time (days before BBD).

Results and Discussion

There was a significant difference ($p<0.05$) for means of table egg weight for both grade B (62.49 ± 0.16g) and C (60.74 ± 0.27g), which were within the range as labelled by producers. However, the eggs are usually weighed in a carton or combined weight at the processing plant and not individually.

There was no interaction effect ($p>0.05$) between the storage temperature and duration on the mean weight of eggs. There was a trend in decreasing mean egg weight over the storage duration for both storage temperatures (Figure 1).

The decrease of egg weight stored at RT was significantly ($p<0.05$) higher rate (15%) compared with egg stored at FT (10%). This could be due to less loss of moisture, carbon dioxide and low evaporation compared with the egg at RT (Scott and Silversides, 2000). The results on the weight change are inconsistent with other studies. Sandıkçı Altunatmaz et al. (2020) observed no changes in the egg weight stored at different temperatures but decrease over time and Jin et al. (2011) reported vice versa. In contrast, both different temperatures and storage duration show no egg weight changes reported by Samli et al. (2005) and Tilki and Saatcı (2004).

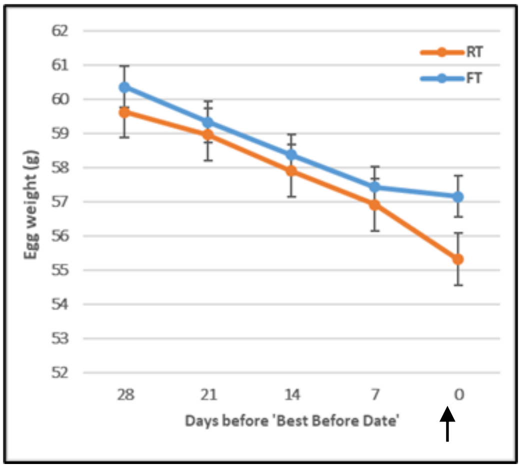

Figure 1. The mean egg weight (g±se) on a different day before BBD, stored at different temperatures (BBD: Best before date, RT: Room temperature (24 to 26ºC); FT: Refrigerator temperature (1 to 10ºC); Arrow: expired day.

There was no significant interaction effect ($p>0.05$) for both storage temperature and storage duration on the shape index and shell thickness of the egg. The shape index of the eggs ranges between 76.3 – 80.0% and it is supported by other studies (Tabidi, 2011; Akter et al., 2014; Sandıkçı Altunatmaz et al., 2020). The shell thickness of eggs in the present study ranged between 0.375 and 0.382 mm. The shell thickness of eggs is influenced by the age, nutrition and environment of the layer hen. The older hen tends to lay a bigger size of an egg which then decreases the shell thickness (Izat et al., 1985). Moreover, stress conditions and nutrition with low calcium also affect the thickness of the egg to become thin (Akter et al., 2014; Chung and Lee, 2014).

There was no significant interaction effect ($p>0.05$) between the storage temperature and duration on the specific gravity of the eggs. The specific gravity of the egg at RT rapidly decreasing ($p<0.05$) until it reached BBD (Table 1).

Table 1. The specific gravity of eggs at the different days before BBD of different storage temperatures

Days before BBD	RT		FT	
	n	Mean±SE	n	Mean±SE
28	18	1.072±0.019[a]	17[1]	1.072±0.002[a]
21	12	1.063±0.01[b]	18	1.066±0.001[b]
14	12	1.060±0.0[b]	12	1.061±0.006[c]
7	12	1.060±0.0[b]	11[1]	1.060±0.0[c]
0	12	1.060±0.0[b]	11[1]	1.060±0.0[c]
Average mean		1.063		1.064

[a-c] Means values with different superscripts within the same column differed significantly (P<0.05). BBD: Best Before Date, RT: Room Temperature (24 – 26ºC), FT: Refrigerator temperature (1 – 10ºC), * [1]number of eggs broken due to handling. N= number of samples.

Similar to Akter et al. (2014) and Aygün and Narinç (2016) who reported the rapid decrease of specific gravity when eggs are stored at RT compared with FT. In this study, there was a significant effect (p<0.05) on the specific gravity of the eggs when stored in FT but it is slightly delayed until 14 days before BBD. This could be due to the size of the air cell of the eggs becomes larger Akter et al. (2014) due to the evaporation of moisture through the shell and causing the egg to float in the low density of water.

There was a significant difference (p<0.05) in the Haugh unit values for both RT and FT at 7 days before BBD. The Haugh unit value for eggs stored at RT was lower than the eggs stored at FT (Figure 2).

The Haugh unit for RT reduces rapidly from 28 (55.4±2.45) to 14 (36.8±3.57) day BBD by 33.6% of the initial value, in comparison with FT. The eggs stored at FT reduce by 8.4% (28- and 14-days BBD, 55.8±3.52 and 51.1±3.72, respectively). The calculated reduction of the Haugh Unit is 2.4% and 0.6% per day for RT and FT, respectively. Even though the Haugh unit for FT decreases, it still can maintain and reach the BBD in line with other studies (Jin et al., 2011; Akter et al., 2014; Fahri et al., 2019). There are missing data for RT (7- and 0-day BBD) due to the EggAnalyzer® machine being unable to give the reading for the eggs with watery albumen.

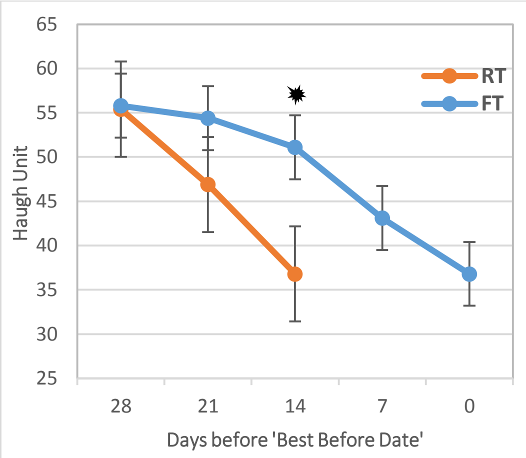

Figure 2. The quality of eggs (Haugh unit±se) on a different day before BBD and stored at different temperatures (RT or FT). BBD: Best Before Date, RT: Room Temperature (24 – 26ºC), FT: Refrigerator temperature (1 – 10ºC); Arrow: expired day; ✸p < 0.05.

The Haugh unit is a standard used to indicate one of the internal egg quality parameters where it involves measuring the height of thick albumen. In a poor quality of eggs, the thick albumen structure started to deteriorate, reduce in thickness and spread. This is because the moisture and carbon dioxide losses affect the pH to increase and subsequently cause ovomucin in thick albumen to break down (Conrad and Scott, 1939). The ovomucin is a glycoprotein that acts as a gelling agent for albumen (Wang et al., 2019). As a result, albumen loses in viscosity and turned into a watery texture.

There was a significantly different (p<0.05) egg yolk width value for RT compared with FT (Table 2) The width of the yolk increased from 28 days before BBD until it reaches BBD which was supported by Akter et al. (2014). However, there were no significant differences (p>0.05) for yolk width in FT and the egg yolk width was maintained until 0 days before BBD. The eggs that are exposed to high temperatures for a long duration will cause the yolk to absorb water from albumen and caused its size to increase. The vitelline membrane that holds the yolk becomes weak and resulted in a flat yolk (Tabidi, 2011).

Table 2. The mean egg yolk width (mm±se) of eggs stored at RT and FT on different day before BBD.

Days before BBD	RT	FT
28	4.14±0.05[c]	4.05±0.05[a]
21	4.56±0.09[b]	4.15±0.04[a]
14	4.78±0.08[b]	4.14±0.06[a]
7	5.34±0.10[a]	4.16±0.07[a]
0	5.33±0.16[a]	4.01±0.06[a]

[a-c] Means values with different superscripts within the same column differed significantly (P<0.05). BBD: Best Before Date, RT: Room Temperature (24 – 26ºC), FT: Refrigerator temperature (1 – 10ºC)

There was no significant difference (p>0.05) on the egg yolk colour score between both RT and FT and its range from score 5 to 9. The colour of the yolk depends on the amount of carotenoids present in the feed of the hen. Feeds such as marigold flowers, corn and paprika are used to provide more carotenoids to give the higher intensity of the colour (Grashorn, 2016).

The percentage of yolk weight had no changes (p>0.05) over the time of storage for RT but increased over time of storage in the FT (p<0.05). There was no data on 7 and 0 days before the BBD for the RT because yolk quality became deteriorated and broken as eggs were cracked (Table 3). This is because, during storage, water from albumen migrates to yolk that causing yolk weight to increase (Jin et al., 2011; Akter et al., 2014). In contrast, Sandıkçı Altunatmaz et al. (2020) found no significant difference in storage time and temperature on yolk weight percentage. In this study, the percentage of yolk weight was lower than those reported from previous studies (ranges 30% - 32%).

The percentage of albumen weight was a significant difference (p<0.05) of RT and FT over time. There was a decline in the percentage of albumen weight from 28 days until 14 days before BBD with a lower value than FT. Nevertheless, FT has a significant decrease (p<0.05) in the percentage of albumen weight. The decrease in the percentage of albumen weight was caused by the movement of water from albumen to yolk via the vitelline membrane. These also affect yolk flattening as discussed by Tabidi (2011). Based on the percentage of albumen weight, the average value was 60%.

There is also no effect (p>0.05) of storage temperature and time on shell weight percentage. Shell weight of the egg is determined by the nutrition, environmental and genetic factors of a hen. Exposure of hen to high temperature with inadequate nutrient intake can cause the shell to become thin and resulted in less weight of the shell (Akter et al., 2014; Sandıkçı Altunatmaz et al., 2020). The mean percentage of shell weight for RT and FT was 10.24 and 10.06, respectively. The average shell proportion of an egg was ranged between 9% and 11%.

Table 3. The proportion of egg yolk, albumin and shell weight (%) of eggs at RT and FT on different days before BBD.

Days before BBD	RT			FT		
	% Yolk	% Albumen	% Shell	% Yolk	% Albumen	% Shell
28	26.4±0.60	63.5±0.58^{b}	10.1±0.07	25.1±0.55^{c}	64.9±0.49^{a}	10.1±0.15
21	26.9±0.61	62.7±0.64^{ab}	10.2±0.15	26.9±0.59^{b}	63.0±0.60^{b}	10.0±0.16
14	27.5±1.09	61.9±1.10^{a}	10.2±0.25	27.9±0.67^{ab}	62.2±0.74^{bc}	9.9±0.17
7	-	-	10.5±0.30	29.2±0.44^{a}	60.4±0.45^{c}	10.3±0.19
0	-	-	10.3±0.19	29.6±0.46^{a}	60.4±0.47^{c}	10.1±0.20

$^{a-c}$ Means values with different superscripts within the same column differed significantly (P<0.05). BBD: Best Before Date, RT: Room Temperature (24 – 26ºC), FT: Refrigerator temperature (1 – 10ºC).

Conclusion

Results from this study proved that the information stated on the packaging were true. The weight of eggs was higher than the standard weight range as stated on the label. Moreover, egg quality can maintain longer (four weeks) or until the day before 'Best Before Date' if stored at refrigerator temperature. Finally, it is recommended for the consumers to consume eggs within 14 days before the 'Best before date' if the eggs are stored at room temperature, 28 days if stored in the refrigerator. The producers should provide storage instruction in all types of eggs in the market as for now they only provide for the designer egg.

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