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# Evaluation of chicken egg quality collected from different marketing channels in Proddatur, YSR Kadapa district, Andhra Pradesh

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**Abstract**
The present study was designed to know the quality of chicken eggs collected from different marketing channels viz., Wholesale shops, Retailers and Interior Vendors in Proddatur town of Kadapa district, Andhra Pradesh. A total of 360 eggs were collected randomly and evaluated for external and internal quality parameters *viz.*, egg weight, volume, specific gravity, shape index, cleanliness, shell soundness, shell texture, shell thickness, Albumen index, Haugh Unit and Yolk Index. Results revealed that eggs collected from interior vendors recorded significantly ($P$<0.05) poor external and internal quality parameters. Within the interior vendors 18.33% eggs were under weight, 26.66% eggs were dirty, 16.66% eggs were cracky, 12.5% have rough texture, 18.33% eggs have lower specific gravity, 11.58% were spherical shaped, 17.58% were elongated, 14.16% have lower shell thickness, 13.33% eggs have lower Albumen index and Haugh Unit and 19.16% eggs have lower Yolk index. Based on the results, it was concluded that eggs collected from interior vendors in Proddatur region have poor external and internal quality when compared to wholesalers and retailers.

**Keywords:** Chicken eggs, marketing channels, external quality and internal quality

## Introduction
Chicken eggs have been traditionally considered as an important source of nutrients like proteins, lipids, minerals and vitamins for humans. It provides easily digestible fats, wherein the proportion of much desired un saturated fatty acids is more as compared to most other livestock products. Hence chosen by WHO as reference protein source. The wide variety of poultry production system and low price of egg make them widely accessible to rural and urban population. Egg quality is composed of those characteristics of an egg that affects its acceptability to consumers such as cleanliness, freshness, egg weight, shell quality, yolk index, albumen index, Haugh Unit and chemical composition (Song *et.al*, 2000) [31]. Egg quality is relatively unstable and begins to deteriorate immediately after it has been laid due to loss of moisture and $CO_2$ through the pores on the shell surface by diffusion (Jinan rat *et al*., 2010) [16], which leads to changes in egg quality. Egg shells act as hermetic seals that guard against bacteria invasion (Wikipedia, 2012) [33] and the shell membranes function to retain the fluid of the albumen and also to resist bacterial invasion (Hassan and Aylin, 2009) [14]. Egg shell and internal quality may be affected by the strain and age of hen; induced moult; nutritional factors such as calcium, phosphorus, vitamins, water quality, non-starch polysaccharides, enzymes, contamination of feed; storage time; stress; diseases, production system, or addition of proprietary products to the diets (Juliet R. Roberts 2004) [17]. Albumen quality is an important indicator for the egg freshness (Bozkurt and Tekerli, 2009) [8]. Scott and Silversides (2001) [28] reported that the ovo mucin in albumen is diminished with increasing storage ever more, which causes thinning in the egg albumen and the albumen height decreases. Haugh Unit is considered to be a typical measure of albumen quality. The Higher value of Haugh unit corresponds to better quality of eggs (Adamiec *et al*., 2002) [2]. Proper storage of eggs is essential to preserve quality and cooking characteristics. Shenga *et al.*, (2010) [29] reported that Haugh unit, albumen and yolk indices of both raw and pasteurized eggs progressively declined with storage time.
Hence the present study was conducted in order to determine external and internal quality of egg by using different parameters such as egg weight, volume, shell colour, texture, shape index, surface area, yolk index, albumin index and shell thickness and shell weight which are related to egg production and marketing features.

## Materials and Methods

A total of 360 eggs were collected by simple random sampling from three different marketing channels which includes 10 shops from each marketing channel i.e., Wholesalers, Retailers and Interior vendors. Egg weight was measured with weigh balance after washing and drying with towel to remove contaminants from shell. The egg was broken gently by using a scalpel and its contents were taken on the flat glass plate. Specific gravity is the ratio of the weight of an object to the weight of an equal volume of water. Shape index was calculated by following formula.

$$\text{Shape Index} = \frac{\text{maximum width (mm)}}{\text{maximum length (mm)}} x100$$

The surface area of egg was calculated using the following relationship cited by Carter, (1975) [9], where S is the surface area in $cm^2$ and EW is the egg weight in g.

$S = 3.9782xEW^{0.7056}$

The egg yolk diameter, albumen length and albumen width (mm) were measured with a digital calliper. The albumen and yolk height (mm) was measured using a spherometer. The yolk (YI) and albumen (AI) indices were calculated using the following formulae as described by Doyon *et al*. (1986):

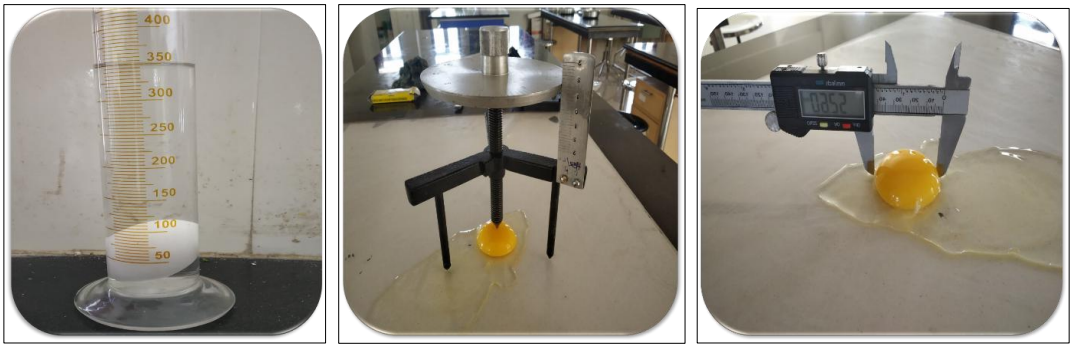
$$YI = \frac{\text{Yolk Height}}{\text{Yolk Diameter}}$$

$$AI = \frac{\text{Albumen Height}}{(\text{Albumen length} + \text{Albumen width})/2}$$

The Haugh Unit (HU) score was calculated using the formula as described by Haugh (1937):

$HU = 100 \times \log (H + 7.5 – 1.7W0.37)$

Where:
H – Albumen height (mm); W – egg weight (g)
The egg shell thickness (mm) was measured after removing the internal membranes of the eggshell, using a screw guage which has the precision of 0.01 mm. Measurements were taken at three regions (middle and two ends) of the shell and then averaged.
The measurement of egg volume length, shell thickness, height and width of yolk were shown in figure 1-5.




1. Egg Volume 2. Height of the Yolk 3. Width of the Yolk

4. Shell Thickness 5. Egg Length

**Fig 1-5:** Measurement of egg volume length, shell thickness, height and width of yolk

## Results & Discussion

### Statistical analysis

Least square means, correlations and percentage analysis was carried out using SPSS version 20.0.

### External quality parameters

Least squares means of different egg quality parameters were presented in Table 1. Percentage of abnormal eggs from different marketing channels were depicted as multiple bar diagram in figure 6. External and internal abnormalities of the defective eggs were depicted in figures 7 to 18.

### Egg weight & volume

Average weight of chicken egg produced in India is 55gms (International Egg Commission). The results revealed that 6.66 %, 9.16 % and 18.33 % of the eggs were under.
Weight from Whole sales, Retailer and Interior vendors respectively. Among the marketing channels eggs from interior vendors significantly ($P$<0.05) recorded lower weight than others which might be due to increase of storage time, by the diffusion of water and $CO_2$ through the eggshell (Michael Grashorn, 2016) [18], transportation of eggs until it reaches the consumers, exposure to sun light at vendors and retailers results in decreased albumen weight and increased albumen dry matter (Bekele *et al.*, (2010) [7]. This study was analogous to studies reported by Bekele *et al.*, (2010) [7] and Ewonetu K. S. *et al.*, (2016) [11].

**Appearance**

Among the marketing channels when compared with the wholesalers and retailers, 26.6 % of the eggs from interior vendors were dirty, 16.66 % of the eggs were cracked, 12.5 % of the eggs have sandpaper or rough shells, 8.33 % of the eggs have pimples. The above abnormal appearance might be due to ageing, poor nutrition, rough handling, long term storage, low purchase capacity and diseases.

**Specific gravity**

Eggs (19.16 %) collected from interior vendors recorded significantly ($P$<0.05) lower specific gravity than retailers and whole salers which might be due to underweight of eggs from interior vendors. Specific gravity is highly correlated to egg shell thickness. As specific gravity goes down the number of cracks generally increase. Specific gravity gives the producer an idea of the probability of the eggs being cracked during handling **(**Gary D). Specific gravity decreases with storage reference (Samli, H. E, 2005) [25].

**Shape index**

Shape index values were within the reference range (70-74) Romanoff AL and Romanoff A (1949) among wholesalers and retailers where as varied shape index values were observed among the eggs collected from internal vendors. Varied shape index of eggs may be either round (11.583 %) or elongated (17.583 %), which are purchased only by poor community people who are residing in the areas near by interior vendors as they sold at low cost. Mis-shapen eggs have poor appearance and do not fit well in egg cartons; therefore, they are much more likely to be broken during the shipment than the eggs of normal shape (Sarica and Erensayin, 2009) [27].

**Shell thickness**

Normal mean eggshell thickness is 0.33 mm. (Nys, 1999) [20]. Significantly lower ($P$<0.05) shell thickness values were recorded for the eggs collected from interior vendors (14.16 %) than others. Shell thickness is an indirect measurement of shell strength. Exposure of eggs to higher temperatures (above 21°C) during storage period result in a reduction in shell thickness which will be more serious when humidity is high (Peterson 1965) [22]**.**

**Internal quality parameters**

**Albumin index**

Significantly ($P$<0.05) lower values of albumin index had been observed in eggs collected from interior vendors (13.33 %) when compared with other eggs which might be due to the binding capacity of ovo mucin and decrease in lysozyme with storage time, resulting in reduced viscosity of albumen (Acker and Ternes, 1994) [1]. Decrease in albumen height might be attributed to proteolysis of ovo mucin, cleavage of disulphide bonds, interactions with lysozyme and changes in the interaction between α and β ovomucins (Silversides and Budgell, 2004) [30]. The results were on par with the results recorded by Rajkumar *et al*, (2009) [23] and Ewonetu K. S. *et. At*., (2016) [11].

**Haugh unit**

Fresh eggs should have a Haugh Unit of 72-110 Stadelman and Cotterill (2007) [32]. Among the marketing channels 13.33 % of the eggs collected from interior vendors recorded significantly ($P$<0.05) lower Haugh Unit scores than the others which might be due to breakdown of carbonic acid in the egg white which produced carbon dioxide and water. The loss of carbonic acid from the egg white and the change in pH due to alkaline state caused the mucin fibres which give egg white its gel structures to lose strength and structure and white became watery which led to loss in Haugh unit of eggs during storage. Similar results were demonstrated by other researchers Samli *et al*. (2005) [25], Akyurek and Okur, (2009) [4].

**Yolk index**

A fresh good quality egg typically shows a yolk index of around 0.45 (Funk, 1948) [12]. The lower YI in interior vendors (19.16 %) in the current study might be caused by a diffusion of water from the albumen to the yolk through retention at interior vendors. The strength of the vitelline membrane decreases during storage due to the yolk absorbing water making the yolk more susceptible to breaking. The flattening of the yolk is primarily due to increase in water content caused by osmotic migration from the albumen through the vitelline membrane. The results were in accordance with the results reported by Staldelman and Cotteril (2007) [32] and Nadia *et al*., (2012) [19].

**Table 1:** Least square means of effect of different marketing channels on external and Internal quality of table eggs

| Quality Parameters | Wholesale | Retailers | Interior vendors |
|---|---|---|---|
| **External Quality Parameters** | | | |
| Egg weight | 57.44± 1.04$^{b}$ | 53.95± 0.69$^{a}$ | 51.36± 4.21$^{a}$ |
| Egg volume | 51.31± 1.23$^{b}$ | 47.73± 3.16$^{a}$ | 45.88± 1.56$^{a}$ |
| Specific gravity | 1.10± 0.44$^{c}$ | 1.01± 1.45$^{b}$ | 0.82± 0.86$^{a}$ |
| Shape Index | 72.32 ± 1.42 | 73.77 ± 0.85 | 75.49 ± 0.62 |
| Shell Thickness | 0.34 ± 7.74$^{c}$ | 0.23 ± 9.28$^{b}$ | 0.16 ± 2.15$^{a}$ |
| **Internal Quality Parameters** | | | |
| Albumin index | 0.186 ± 3.87$^{c}$ | 0.097 ± 5.28$^{b}$ | 0.07 ± 4.03$^{a}$ |
| Haugh unit | 71.11 ± 1.94$^{c}$ | 62.01 ± 1.81$^{b}$ | 46 ± 2.43$^{a}$ |
| Yolk index | 0.486 ± 3.88$^{b}$ | 0.405 ± 3.21$^{b}$ | 0.318 ± 1.62$^{a}$ |

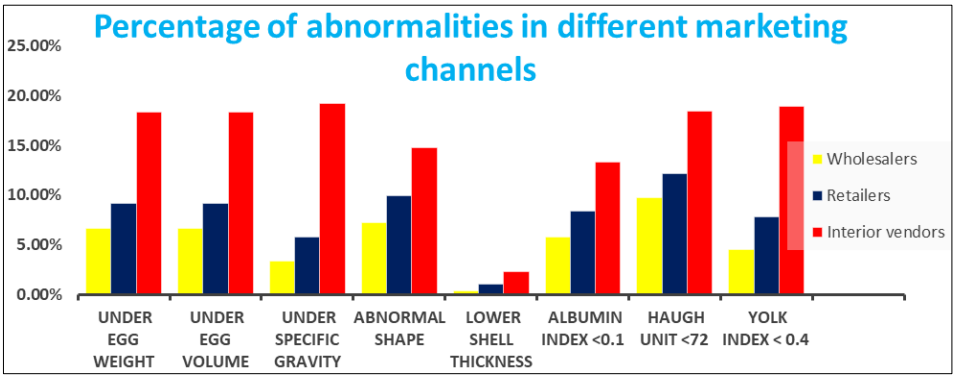



**Fig 6:** Percentage of abnormalities from different marketing channels

**7. Variation in egg Size**

**8. Normal egg vs misshapen egg**

**9. Crack and mildew egg**

**10. Rough texture egg vs Normal egg**

**11. Faecal stains**

**12. Hen Feather attachment**

**13. Flat sided egg**

**14. Pimpled Egg**

**Internal defects**

**15. Leakage of Yolk** **16. Blood Spots** **17. Watery White** **18. Addled Egg**

**Fig 7-18:** External and Internal abnormalities of defective eggs

**Correlation between Egg shape index and egg quality parameters**

Correlation coefficient values between Egg shape index and egg quality parameters were presented in Table 2. Positive correlation was observed between egg shape index with egg weight and volume which may be due to the reason that denser part of the egg (Albumen) occupying the width area, which translates to heavier weight for the egg. The results were in agreement with the results noted by Aktan (2005) [3] and Alkan *et.al,* (2013) [5]. Significant Negative correlation was observed between egg shape index and specific gravity (*P<0.05*) which was in accordandance with the results of Ozcelik (2002). Positive correlation was observed between egg shape index with shell thickness, Albumin index, Haugh unit and yolk index. The results are on par with the results reported by Begli *et al* (2010) [6], Sarica *et al,* (2012) [26] and Yilmaz *et al*, (2011), Alkan *et al* (2013) [5].

**Table 2:** Correlation between egg shape index and Egg quality Parameters.

| Quality characteristics | Wholesale | Retailer | Interior vendors |
|---|---|---|---|
| **External Quality parameters** | | | |
| Egg weight | 0.18 | 0.14 | 0.16 |
| Egg volume | 0.312 | 0.322 | 0.298 |
| Specific gravity | -0.079 | -0.067 | -0.043 |
| Shell thickness | 0.109* | 0.203* | 0.221* |
| **Internal Quality Parameters** | | | |
| Albumin index | 0.009 | 0.009 | 0.070 |
| Haugh unit | 0.360 | 0.316 | 0.308 |
| Yolk index | 0.052 | 0.046 | 0.094 |

(Note: *$P<0.05$)

**Conclusion**

As a conclusion marketing channels significantly influences egg quality with higher quality observed in eggs collected from wholesalers. The quality of eggs gradually declines from wholesalers to retailers; retailers to interior vendors. Accordingly, this study indicates to the need of quality improvement in short marketing chains. Hence, awareness about the management and carefull handling practice of eggs should be organized to create well-informed vendors, retailers and consumers to offer safe and good quality eggs for consumption. They should be endeavor to store and retail their eggs under refrigeration or good sanitary condition and where facilities are not available; eggs must be stored and protected from direct sun light.

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