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Quality and microbial load of chicken table eggs procured from different markets of Tirupati, Andhra Pradesh: A comparative study

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Abstract
A study was conducted to comparatively evaluate the quality and microbial load of table eggs collected from different locations in Tirupati. Eggs were collected from college farm in veterinary college Tirupati, Commercial farm, Retail outlet and wholesale market. These eggs were tested for and parameters like shape index, albumen index, yolk index as well as microbial load. The eggs collected from wholesale market had significantly higher ($P<0.05$) egg weight and shell quality and other parameters were significantly similar. However, the eggs collected from different location were fit for consumption.

Keywords: Table eggs, microbial load, markets, Andhra Pradesh

Introduction
Egg has been accepted worldwide as a staple food and included as an important ingredient for all age groups in a balanced human diet. Egg quality can be defined as the "characteristic of an egg that affect its acceptability to the consumers". The shell can already be infected when passing through the vent, but many researchers suggest that the main contamination occurs within a short period after laying due to contact with dirty surfaces (Harry, 1963 [13]; Board *et al*., 1964 [3]; Quarles *et al*., 1970 [23]; Gentry and Quarles, 1972) [10]. Studies on bacterial eggshell contamination concerned research on hatching eggs, because trans-shell contamination of hatching eggs may reduce hatchability (Quarles *et al*., 1970) [23]. Board and Tranter (1995) [4] reported that the extent of contamination of hatching eggs was in the range from 2 up to 7 log (10^2 up to 10^7) colony forming units (CFU) per eggshells. In egg washing experiments, Knape *et al*. (2002) [18], Favier *et al*. (2000) [8], Knape *et al*. (1999) [17] and Lucore *et al*. (1997) [21] reported an average initial eggshell contamination of 6.33, 4.55, 3.86 and 5.10 log CFU/ eggshell respectively. Until recently, little was known regarding bacterial contamination of table eggs. It is hypothesized that bacterial contamination of the egg content could result from the penetration of the shell by bacteria deposited on the surface of the egg after it has been laid; this is also called the horizontal infection route (Haines, 1938; Harry, 1963 [12, 13]; Quarles *et al*., 1970 [23]; Schoeni *et al*., 1995) [25]. Smith *et al*. (2000) [26], Messens *et al*. (2005) [22] and De Reu *et al*. (2006) [6] reported that increasing numbers of micro-organisms on the eggshell consequently increase the risk of microbial eggshell penetration and egg content contamination. Beside the horizontal route of bacterial infection of eggs, egg contamination also occurs through the vertical or transovarian route (Bruce and Drysdale, 1994) [5]. In the transovarian route (vertical transmission), the yolk (very infrequently the yolk itself), the albumen and/or the membranes are directly contaminated as a result of bacterial infection of the reproductive organs, i.e. ovaries or oviduct tissue, before the eggs are covered by the shell.

Eggshells can become contaminated with salmonellae either as a result of infection of the oviduct or by faecal contamination. With salmonellae other than *Salmonella enteritidis* the latter route seems to be more important (Humphrey, 1994) [15]. The external and internal qualities of eggs are vital price contributing factors for table purpose and hatching eggs. As the economic success of poultry farming largely depends on the total number of good quality eggs produced, evaluation of external and internal quality of the egg is essential, as consumers prefer better quality eggs. The present investigation has been carried out to comparatively evaluate the Quality and Microbial Load of Chicken Table Eggs procured from different markets of Tirupati, Andhra Pradesh.

Materials and Methods
Eggs from different market sources: 100 eggs from Wholesale market, 100 eggs from Retail outlet, 100 eggs from Commercial Poultry farm, 100 eggs from College Poultry Farm. The eggs were evaluated for quality with regard to shape index, albumin index, and yolk index. The microbial quality of eggs was evaluated by standard plate count (Kuo *et al*., 1997; Kwon *et al*., 1997) [19, 20] in a laminar air flow chamber.

- SPC Agar: SPC Agar is prepared by dissolving 23.5 gm of SPC agar and 5gm agar-agar in 1 litre of distilled water.
- Peptone water: Peptone water is prepared by dissolving 2% peptone and 0.5% NaCl in ditilled water.
- Colony counter.

Shape Index
Measurements of egg length (L) and width (W) were taken with a digital calliper to the nearest 0.01 mm. The egg shape index (SI) was determined from these measurements according to Reddy *et al*. (1979) [24] and Anderson *et al.* (2004) [2] as given with the following formula, Average width of egg/Average length of egg.

Yolk Index
Height of yolk/Average width of egg (Doyon *et al*., 1986) [7].

Albumin Index
Height of albumin/average width of albumin (Doyon *et al*., 1986) [7]. Initially one cubic centimeter is drawn randomly on each and every egg shell surface. Later peptone water and SPC Agar prepared are autoclaved. Ten test tubes for each egg sample are prepared, first test tube containing 10 ml of peptone water and remaining all with 9 ml of peptone water. By using moist sterile swabs, sample is taken from one cubic centimeter area on egg shell surface by applying gentle pressure without breaking the eggshell. Then this sterile swab is taken into the first test tube and left for 5-7 min, after those serial dilutions are made up to the last test tube (by transferring 1ml) using micro pipette. One ml from appropriate dilutions is taken into Petri plates and SPC agar is added and Petri plates are gently rotated for proper mixture of agar and dilution sample (agar should be cooled i.e., hot agar should not be used).

1. Proper labeling on Petri plates with dilution factor and source of sample should be done. Petri plates are left for solidification. Kept in incubation for 24 hours.
2. After 24 hours, each Petri plate with countable number of bacterial colonies was selected and is divided into four quarters by external marking and one quarter is measured for number of colonies present in it, from all the dilutions. This number is multiplied with 4 to know the total number of colonies in that Petri plate.

Results and Discussion
Significant differences were recorded in the External quality as well as internal quality of eggs procured from commercial egg farms and retail markets. The microbial load of eggs obtained from different markets also had significant variations (Heath *et al*., 1977 and Keerthirathne *et al*., 2020) [16]. However, all the eggs were fit for consumption.

Egg weight
The table indicates that egg weight of eggs collected from whole sale market is significantly higher than the weight of eggs collected from other areas. This can be attributed to proper handling and storage conditions prevailing in this market place. These results are similar to that reported by (Abonajmi *et al*., 2010) who found deterioration in all quantitative parameters especially the weight in eggs stored at room conditions.

Table 1: Results of the Experiment

Parameters	College farm	Commercial farm	Retail outlet	Wholesale market
Egg Quality				
Egg Weight (gm)	52.9±0.23^{ab}	54.7±0.23^{a}	51.09±0.23^{b}	56.01±0.05^{c}
Specific Gravity	1.01±0.12^{b}	0.94±0.58^{a}	0.92±0.43^{a}	0.97±0.52^{a}
Shape Index	72.44±0.26^{a}	74.91±0.24^{ab}	76.81±0.19^{b}	78.83±0.24^{c}
Shell Quality				
Shell thickness (mm)	0.34±0.33^{b}	0.38±0.11^{b}	0.31±0.51^{a}	0.41±0.09^{c}
Shell weight (gm)	5.94±0.11^{b}	6.11±0.14^{c}	5.45±0.34^{a}	6.13±0.35^{c}
Albumen quality				
Albumen height (mm)	0.486±0.49^{a}	0.584±0.65^{b}	0.410±0.65^{b}	0.519±0.80^{c}
Albumen width(mm)	5.25±0.23^{c}	4.63±0.23^{c}	5.46±0.40^{a}	5.25±0.15^{b}
Albumen index	0.093±0.82^{a}	0.126±0.19^{b}	0.075±0.19^{b}	0.114±0.22^{c}
Yolk quality				
Yolk height (mm)	16.7±0.18^{a}	16.8±0.12^{a}	16.2±0.21^{a}	16.9±15^{b}
Yolk width (mm)	31.2±0.21^{a}	36.92±0.24^{a}	39.4±0.19^{c}	37.4±0.12^{b}
Yolk index	0.46±0.24^{a}	0.44±0.27^{a}	0.38±0.33^{b}	0.45±0.18^{a}
Microbial load				
SPC	3.69±0.02^{a}	4.18±0.05b^{c}	4.63±0.33^{c}	3.36±0.02^{a}
Salmonella	Negative	Negative	Negative	Negative

Rows bearing different superscripts differ significantly

Shell strength
The table indicates that egg shell strength of eggs collected from whole sale market is significantly higher than the egg shell strength of eggs collected from other areas. In addition, only slight decrease in shell strength was seen between different groups. Similar result was suggested by Abdelrahman *et al*, (2018) [1] and Habib, (2018) [11] who found no difference in shell strength between eggs collected from a supermarket and a small shop in bahri area of Khartoum City. These results revealed that shell strength is poorly affected by storage conditions.

Albumen index

The table also indicates that albumen index is significantly higher in eggs collected from commercial farm compared to eggs collected from the other sources. Likewise, the small value of high albumin index obtained from eggs collected from commercial farm is similar to Vivian, *et al* (2017) who reported that Haugh unit decrease in eggs when stored at 4 °C for 28 days without refrigeration. The microbial load was lower in college farm and wholesale market compared to commercial market and retail outlet. Although the study did not quantify the aflatoxins and other mycotoxins in the egg contents, their importance is indispensable because of the consumer concern (Hassan *et al*., 2019) [14].

Conclusion

Although significant differences were observed with regard to quality and microbial load of eggs, Eggs procured from all market sources are safe and fit for consumption.

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