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Effect of different Storage time on External and Internal Characteristics of Eggs of Hen (*Gallus Gallus Domesticus*)

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ABSTRACT: The current study was conducted to investigate the effect of storage time on some external and internal characteristics of Golden Breed of hen (*Gallus Gallus Domesticus)* eggs. The duration of the study was two months. A sample of 4 males and 8 females (Golden Breed of hen) were collected from the local village of district Sargodha. Total of 140 eggs were collected and their quality characteristics were measured in the laboratory. The result showed that the external characteristics (Yolk Height, Yolk width, Yolk Weight, Shall Thickness, Egg Weight, Haugh Unit, Albumen Index, Yolk Index and Shape Index) show high significance($p<0.05$), while shell weight, maximum length of egg and maximum width of eggs shows insignificant($p>0.05$) results. As the storage time increases albumin height, albumin Wight, yolk height, haugh unit, yolk index, albumin index decreases. The shell thickens, shape index and shell weight have no specific difference with the increase of days of storage durations. There is no impact of different storage durations on egg weight, maximum length of egg and maximum width of egg. While yolk weight and yolk width increases with the increase of days of storage. Haugh unit and Yolk index is used to determine the quality of eggs, higher the haugh unit and yolk index of egg higher the quality of egg. So it is concluded that increases the storage time decrease the quality of the egg.

Keywords: storage time, egg of *Gallus Gallus Domesticus,* egg quality, external characteristics of egg, internal characteristics of egg.

I. INTRODUCTION

Poultry production is one of the major aspects of animal production with important contribution to food security. It provides many nutritious products, for example, eggs and meat that are rich in protein value [1]. In the poultry industry, the yearly egg yield of hens has increased up to 310 eggs per hen through maintaining rearing systems, the developments in genetics, feeding and health conditions. Apart from increasing egg production, major improvements were observed in egg quality parameters. Hence, the aspects effecting egg quality, like herd genotype, rearing system, health, feeding, age, egg classification, transport, storage, processing technology and marketing, should be well designed [2]. The main difference in old and fresh stored eggs is in pH and quality level of albumin [3]. The pH level of the egg albumen gets higher during storage in refrigerator, which is linked to spoiling of egg albumen quality [4]. The storage timing length, gaseous, heat and aeration, environment in the storage room and conductance through the egg shell is linked with the buffering capacity of albumen [5]. The structure of an egg that is laid by any normal female of certain species of animals as a means of reproduction is as following, the egg is consists of four parts that are; shell, membranes, yolk and albumen. The proportion of each component in freshly laid chicken egg is 32% yolk weight, albumen weight is 58% and shell weight is 10% [6].

The equality of an egg explains the standards which defines both the internal and external qualities of chicken egg. The internal qualities of an egg depend on the size of air cell, shape and height of the yolk, viscosity, strength and blastoderm diameter of albumen. The qualities like thickness, shape, texture, colour and cleanliness of shell are external qualities of an egg [7]. The objective of the present study was to determine the effects of storage time on some external and internal characteristics of chicken eggs.

II. MATERIALS AND METHODS

Collection and Sampling

4 males and 8 female of Golden Breed of hens (*Gallus Gallusdomesticus)* were obtained from the village 41 chak at district Sargodha and kept at the poultry unit. The quality parameters were measured in zoology lab at university of Lahore Sargodha campus. The eggs were collected for a period of three weeks. As they were collected daily after the numbering with their physical

measurements and weights and were grouped in five (5),labeled as day 0, day 7, day 14, day 28 and day 35 groups within the 3 weeks. Total of 140 eggs were collected which were stored at room temperature (15-18^{o}C) at zoology laboratory of university of Sargodha

Egg characteristics

According to storage time eggs were broken and evaluated in days of 0 (n=28), 7(n=28), 14 (n=28), 28 (n=28) and 35 (n=28). During sampling, eggs were weighed and broken on to a flat surface and measurements are taken as:

Height of the albumen

Height of the albumen was measured, half way between yolk and edge of the inner thick albumen by using albumen height gauge.

Diameter of thick albumen

The diameters of the thick albumen were measured using micrometer.

Yolk and shells weight

The yolk was separated from the albumen and weighed. The shells were dried at room temperature and weighed.

Shell thickness.

The shell thickness was measured from the three different parts of shell in each (equator, top and truncated edge) egg using a micrometer and was averaged and recorded as shell thickness.

Weight of the albumen.

The weight of the albumen was calculated as the difference between the weight of the egg and the weight of the yolk and shell.

Haugh unit, albumen index, yolk index and egg weight loss were calculated as follows:

♣ Haugh unit =100 x log (Albumen height+7.57-1.7 x Egg weight0.37)

♣ Albumen index = Albumen height (mm) / [Albumen length (mm) + Albumen width (mm)] x 100

♣ Yolk index = Yolk height (mm) / Yolk diameter (mm) x 100

♣ Egg weight loss = [(Egg weight - Egg broken weight) / Egg weight] x 100

The widths and length of eggs.

The maximum widths and lengths of each egg were measured with calipers

Their shape indices were calculated using the formula:

♣ Shape index = maximum width (mm) / maximum length (mm) x 100

Egg quality characteristics.

External egg quality characteristics collected were egg weight, shell thickness, Shell weight, Max length of egg, Max width of egg and Shape index. The internal egg quality characteristics taken are Haugh unite, Albumen index, Yolk index, Yolk weight, Yolk diameter, Yolk height, Diameter of albumen, Height of albumen.

Statistical analysis.

All data were analyzed with the One-Way ANOVA and the P-value were determined which showed that either the external and internal characteristics of egg are significant or non-significant. The SPSS statistical package was used for data subjection. Further the significant means were compared by Duncan's test.

III. RESULTS AND DISCUSSION

Eggs are economically important and are used by human beings for different purpose. Quality of eggs is related with the internal and external quality parameters of eggs. Eggs of hen are rich in energy and give balance diet for the humans of nearly all stages of ife. Egg quality include all that factors and qualities which affect its acceptance for the consumption to consumers, that's why it's considered notable toward preservation troubles for egg and marketing of eggs for quality maintenance [8]. So we performed our study to investigate the effect of different storage durations on the egg quality of hen (*Gallus Gallusdomesticus*).

We applied one-way ANOVA on all the parameters of each egg of day 0, day 7, day 14, day 21 and day 28 to find out the significance (p-value) of internal and external quality parameters of eggs on the quality of the egg. Albumin height, Albumin Weight, Yolk Height, Yolk Diameter, Yolk Weight, Shall Thickness, Haugh Unit, Albumn Index, yolk inde and Shape Index shows the highest significance while shell weight, maximum length of egg and maximum width of eggs shows significant results and it is found in accordance with the findings of [9]. Further we find out that the yolk width increases with the increase of days of storage durations. From result it is clear that yolk width is significant ($p<0.05$) that changes with the increase of storage duration. Our result is supported by the findings of the [10].

Detail values of one-way ANOVA of all groups (Day 0, Day 7, Day 14, Day 28, Day 35) internal and external characteristics is given in the table 1.

ANOVA is not sure that how many means are same and how many means are different from each other. So in order to find that we have applied Duncan's test for each parameter separately. Duncan's test will also help out to separate the means.

After applying duncan's test it was found that when storage time increases albumin height, albumin Wight, yolk height, haugh unit, yolk index, albumin index decreases. The shell thickens, shape index and shell weight have no specific difference with the increase of days of storage durations. There is no impact of different storage durations on egg weight, maximum length of egg and maximum width of egg. While yolk weight and yolk width increases with the increase of days of storage. Haugh unit and Yolk index is used to determine the quality of eggs, higher the haugh unit and yolk index of egg higher the quality of egg. Further we are going to discuss each parameter in detail below.

Yolk height.

The decrease with the increase of days of storage durations. 0 day eggs have yolk height 6.3932mm, 7 days' eggs have 5.7546mm, 14 days have 5.2468mm, 21 days have 4.9768mm and 28 days have 4.7161mm. Reason that Yolk height decrease with the increase of storage days is due to the evening of yolk which is because of the reason that the amount of water becomes higher in the yolk by a process of osmoregulation from albumin into the yolk through a yolk membrane [11].

Yolk width.

The increases with the increase of days of storage durations. 0 days' eggs have yolk diameter 3.9868mm, 7 days' eggs have 3.9661mm, 14 days have 4.4225mm, 21 days have 5.11006mm and 28 days have 5. 2696mm. These results are happened because yolk membrane gets weaker with the increase of storage days and as the yolk membrane (Vitalline membrane) weakens water from the albumin entered into the yolk causing the increase in the width of the yolk causing the yolk to spread in the albumin. Our result is supported by the findings of the [12].

Yolk weight.

The increase with the increase of days of storage durations. 0 days' eggs have yolk weight 13.3893g, 7 days' eggs have 13.6418g, 14 days' eggs have 14.0696g, 21 days have 14.3229g and 28 days have 14. 4021g. it is clear that with the increase of storage day's weight of yolk also increases and this is because of the sprouting of water from the albumin to the yolk [13].

Shell thickens.

There has no specific difference with the increase of days of storage durations. 0 days' eggs have shell thickens 0.5246mm, 7 days' eggs have shell thickens 0.5429mm, 14 days have shell thickens 0.5289mm, 21 days have shell thickens 0.5371mm and 28 days have shell thickens 0.5600mm. There is no specific difference in the shell thickens of eggs during different storage durations of eggs *Gallus Gallus domesticus.* This result is also found in accordance with the results investigated by [14, 15]. They works on thickens of shell for the eggs of Partridge and eggs of japanese Quail.

Shell weight.

It shows that there is no significant difference in the shell weight of the eggs during different storage durations. 0 days' eggs have shell weight 4.3839g, 7 days' eggs have shell weight 4.2914g, 14 days have shell weight 4.5250g, 21 days have shell weight 4.4554gand 28 days have shell weight 4.3018g. There is no specific difference in the shell weight of eggs during different storage durations of eggs *Gallus Gallus domesticus.* And this investigation is in accordance with the inquiry of [16]. As they also found that the different storage durations did not affect the shell weight of the eggs. Maximum

Length of Egg.

It is shown which shows that there is no significant difference in the maximum Length of the eggs during different storage durations. 0 days' eggs have maximum Length of Egg 5.1404cm, 7 days' eggs have maximum Length of Egg 5.0921cm, 14 days have maximum Length of Egg 5.1321cm, 21 days have maximum Length of Egg 5.0246cmand 28 days have maximum Length of Egg 5.0711cm. Hence there is no impact of different storage durations on maximum Length of Eggs of *Gallus Gallus domesticus.*

Width of Egg.

It is shown which shows that there is no significant difference in the maximum Width of Eggs during different storage durations. 0 days' eggs have maximum Width of Egg 3.2711cm, 7 days' eggs have maximum Width of Egg 3.1754cm, 14 days have maximum Width of Egg 3.1641cm, 21 days have maximum Width of Egg 3.1982cmand 28 days have maximum Width of Egg 3.0986cm. There is no impact of different storage durations on maximum Width of Egg of *Gallus Gallus domesticus.*

Egg weight.

Itshows that there is no significant difference in the egg weight of the eggs during different storage durations. 0 days' eggs have egg weight 38.6539g, 7 days' eggs have egg weight 38.8425g, 14 days have egg weight 38.8843g, 21 days have maximum egg weight 38.8311gand 28 days have egg weight 39.0518g.This result is supported by the findings of [9], who works on the partridge eggs. There is no impact of different storage durations on egg weight of eggs of *Gallus Gallus domesticus.*

Haugh Unit.

It shows that there is a significant difference in the Haugh Unit of the eggs during different storage durations. 0 days' eggs have Haugh Unit of 90.8632, 7 days' eggs have Haugh Unit of 86.8293, 14 days have Haugh Unit of 81.8646, 21 days have Haugh Unit of 79.8596 and 28 days have Haugh Unit of 72.8757. This data shows the notable decreases in the Haugh Unit of the eggs with increase of the storage durations of eggs and this depletion of Haugh Unit is due to the decline in the albumen height. This result is supported by the findings of [16], who observed that the haugh unit significantly decline during the twenty-first day of storage.

Height of the albumin.

It decreases causing the decrease in the HU because enzyme complex in the albumin breaks causing the increase in the egg PH albumen Index is shown, which shows that there is a significant difference in the albumen Index of the eggs during different storage durations. 0 days' eggs have albumen Index 18.9161%, 7 days' eggs have albumen Index of 15.9818%, 14 days have albumen Index of 14.1039%, 21 days have albumen Index of 12.1229% and 28 days have albumen Index of 9.9554%. This data shows the notable decreases in the albumen Index of the eggs with increase of the storage durations of eggs and this depletion of albumen Index is due to the decline in the albumen height. This result is supported by the findings of [17], who also found that albumen index decreases as the storage duration increases. Different time of storage deleterious effect the albumen Index of the eggof *Gallus Gallus domesticus.*

Yolk Index.

Itshows that there is a significant difference in the yolk Index of the eggs during different storage durations. 0 days' eggs have yolk Index 141.0950%, 7 days' eggs have yolk Index of 113.1607%, 14 days have yolk Index of 103.0925%, 21 days have yolk Index of 101.1571% and 28 days have albumen Index of 98.9861%. This data shows the notable decreases in the yolk Index of the eggs with increase of the storage durations of eggs and this depletion of yolk Index is due to the decline in the yolk height. This result is supported by the findings of [17], who also found that yolk index decreases as the storage duration increases. Different time of storage deleterious effect the albumen Index of the eggof *Gallus Gallus domesticus.*

S***hape Index.***

It shows that there is not much difference in the shape Index of the eggs during different storage durations. 0 days' eggs have shape Index 67.0307%, 7 days' eggs have shape Index of 66.9932%, 14 days have shape Index of 66.1871%, 21 days have shape Index of 66.1746%. and 28 days haveshape Index of 66.0375%. hence different storage durations did not significantly affect the shape index of the egg and our result is found in accordance with the findings of [18]. They also found that different storage durations did not affect the shape index of the eggs of *Gallus Gallus domesticus*

Albumin.

It shows that albumin height decreases with the increase of storage durations of eggs. 0 days' eggs have Albumin height 7.66241mm, 7 days' eggs have Albumin height of 6.9839, 14 days have Albumin height of 6.4214mm, and 21 days have Albumin height of 5.8939mm and 28 days have Albumin height of 5. 6624mm.hence different storage durations significantly affect the albumin height of the egg and this is due to the reason that water diffuses into the yolk from the albumin as the storage time increases and our result is found in accordance with the findings of [19, 20].

Albumin weight.

It shows that albumin weight decreases with the increase of storage durations of eggs. 0 days' eggs have Albumin weight 7.3685g, 7 days' eggs have Albumin weight of 5.7081gg, 14 days have Albumin weight of 4.8682g, and 21 days have Albumin weight of 4.7532g and 28 days have Albumin weight of 4.2767mm, hence different storage durations significantly affect the albumin weight of the egg. This is because of the reason that the solvent from the albumin diffuses into yolk causing the increase in the weight of the yolk. [19, 20] also found the same results and said that the increase of storage duration causes the desiccation of water from the albumin resulting in the decrease of weight of the albumin.

So from all above results and our study confirms that the increase of storage duration badly affects the quality parameters of the egg by decreasing albumin height, albumin Weight, yolk height increasing yolk weight, reducing haugh unit, affecting albumin index, yolk index, shap index.

Table 1: Detail result of the experiment.

ONE WAY ANOVA						
		Sum of Squares	**Df**	**Mean Square**	**F**	**Sig.**
Yolk Height	Between Groups	49.870	4	12.467	140.380	.000
	Within Groups	11.990	135	.089		
	Total	61.859	139			
Yolk width	Between Groups	43.109	4	10.777	140.234	.000
	Within Groups	10.375	135	.077		
	Total	53.484	139			
Yolk Weight	Between Groups	21.449	4	5.362	62.045	.000
	Within Groups	11.667	135	.086		
	Total	33.116	139			
Shall Weight	Between Groups	1.121	4	.280	1.530	.197
	Within Groups	24.716	135	.183		
	Total	25.836	139			
Shall Thickness	Between Groups	.021	4	.005	7.552	.000
	Within Groups	.096	135	.001		
	Total	.117	139			
Maximum Length Egg	Between Groups	.251	4	.063	1.310	.269
	Within Groups	6.457	135	.048		
	Total	6.708	139			
Maximum Width Egg	Between Groups	.437	4	.109	1.660	.163
	Within Groups	8.892	135	.066		
	Total	9.330	139			
Egg Weight	Between Groups	2.260	4	.565	4.438	.002
	Within Groups	17.186	135	.127		
	Total	19.446	139			
Haugh Unit	Between Groups	5283.045	4	1320.761	16759.437	.000
	Within Groups	10.639	135	.079		
	Total	5293.684	139			
Albumn Index	Between Groups	1337.156	4	334.289	2659.651	.000
	Within Groups	16.968	135	.126		
	Total	1354.124	139			
Yolk Index	Between Groups	33960.672	4	8490.168	4.746	.001
	Within Groups	241513.873	135	1788.992		
	Total	275474.545	139			
Shape Index	Between Groups	464.431	4	116.108	17.892	.000
	Within Groups	876.087	135	6.490		
	Total	1340.518	139			

IV. CONCLUSION

The current study was conducted to evaluate the effect of storage time on external and internal characteristics of the eggs of *Gallus Gallus domesticus*. From the results it was concluded that the albumin height, albumin weight, yolk height, yolk width, yolk weight, shall thickness, egg weight, haugh unit, albumen index, yolk index and shape Index of eggs showed high significance ($p<0.05$), while shell weight, maximum length of egg and maximum width of eggs shows insignificant($p>0.05$) results. As the storage time increases albumin height, albumin Wight, yolk height, haugh unit, yolk index, albumin index decreases. The current study demonstrates the importance of storage time on the characteristics of chicken eggs.

Conflict of Interest. The authors declared no conflict of interest.

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