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Effect of Breed and Management System on Some External and Internal Physical Egg Characteristics

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Abstract
The aim of the study was to determine the effect of housing system and breed on some external and internal egg quality characteristics. The investigated eggs came from local Sudanese baladi and Hi-sex commercial laying hens, as well as from traditional and semi close system of housing. Egg quality assessment was based on the following external egg traits: weight, shell index, egg volume, surface area, shell weight, shell thickness, specific gravity; physical features of egg content: albumen height, albumen weight, value of Haugh units, yolk weight, yolk volume and yolk- albumen (%). Eggs with the highest weight, shell index, egg volume, surface area, shell weight, shell thickness, specific gravity were laid by commercial Hi-sex hens, on the other hand, the effect of breed on the internal quality traits followed the same trend except for yolk –albumen (%) in which baladi breed showed higher yolk – albumen (%) compared to Hi-sex commercial layer. Semi close system of housing significantly increase surface area, shell weight, shell index and specific gravity. No effect of management system on egg weight, egg volume, shell thickness and egg yolk volume were observed.
Keywords: surface area, Haugh unit, specific gravity, Vernier caliper

Introduction
A key component of maintaining the healthy diet is to consume adequate and balanced amount of animal -based products. The egg is one of the excellent of animal protein sources . The characteristic of egg protein source affect it's acceptability to the consumers in the world, therefore monitoring and evaluation of external and internal quality of chicken is important in production economy. Egg quality is the general term which refers to general standards which define both external and internal egg quality such as egg weight, shell weight, shell thickens, surface area albumen weight, Haugh unit and yolk weight, (Oluyemi and Roberts., 2000). Different internal and external egg quality characteristics are of high importance in analyzing egg quality (Silversides and Scott, 2001). One of the biggest challenges of human beings is to maintain healthy diet, which is strongly associated with life quality. There are many factors effecting egg characteristics such as breed and housing system has been observed by researchers. The effect of breed on the egg characteristics was reported by Washburn,

(1990), Hanusova, *et al*., (2015), Sokotowicz *et al*. (2018), and Abou El-Ghar (2019); while the effect of housing system was reported by Holt *et al*. (2011) and Sokotowicz *et al*. (2018). The objective of this study to highlight the effect of breed (Hisex, Sudanese Baladi) and management system (traditional and semi close) on some external and internal egg characteristics.

Materials and methods

Materials and methods

A total of 204 eggs were used in the study, 136 eggs were collected from Hisex birds (n= 68) kept under traditional and semi close systems (68 eggs each), while 68 eggs were collected from Sudanese Baladi kept under traditional management system. The eggs were brought to the laboratory and kept at room temperature. The following egg characteristics were determined for all eggs**.**

Egg weight and shell weight (g): Egg weight was determined by weighing each individual egg and shell weight was determined by difference after breaking the egg. Digital balance was used in the determination of both parameters

Egg volume (cm^3): Egg volume was determined by immersing the egg in a container filled with water. The water which was removed from the container equal to the egg volume.(according to Archimedes principle.

Shell thickness (mm): The egg shell thickness was determined by using micrometer screw gauge .**Specific gravity:** It was determined according to Hamliton (1982).

Surface area (cm^2): It was calculated according to Carter (1975). Surface area 4.76 X (egg weight(g) $^{0.67}$.

Shell index: shell index = shell weight (g)/ surface area (cm^2) X100 Sauveur (1988**)**

Albumen height (mm): Vernier caliper was used to determine the albumen height

Yolk volume (ml): After the yolk was separated from the albumen then it was rolled over filter paper to remove albumen residues from the yolk, the yolk was poured into 50 ml tube with known weight, then yolk volume was recorded.

Yolk weight (g): Yolk weight was calculated by subtracting the weight of the empty tube from the weight of tube with yolk.

Haugh unit: Haugh unit was determined using an egg quality slide rule, which was designed by Brant and Norris of the U.S Department of Agriculture. The egg quality slide rule was designed to estimate Haugh units according to the following equation described by Brant et al. (1951).

$$H.U = 100 \times \log \left[H - \frac{\{G\}\ 0.5\ (30\ \{W\}\ 0.37 - 100) + 1.9}{100} \right]$$

Where:

H.U: Haugh units
W: egg weight in grams
H: albumen height in millimeters
G: 32.2

Albumen weight (g): Albumen = Albumen = Egg weight (g) - (Yolk weight (g) + Shell weight (g)).

Yolk-Albumen (%): yolk- albumen % = (yolk weight / albumen weight) x 100.

Statistical analysis: The effect of breed and management was statistically determined using independent T test according to Steel and Torrie (1996). The SPSS computer

program was used for the analysis of data collected.

Result and discussion:-

Research findings relating some external egg characteristics including Egg weight, egg volume, surface area, shell weight, shell thickness and specific gravity. Were significantly (P<0.001) affected by breeds, The results agree with, Zita, *et al*.(2008), Hanusová, *et al*.(2015), Tumova, *et al*.(2016), Sokotowicz, *et al*. (2018) and Kraus and Zita.(2019). The values of external egg quality parameters were higher in Hisex compared to Sudanese Baladi is probably due to selection for increased laying performance (table, 1). On the other hand shell index was not affected by breed, (Anderson, *et al*.2004 and Markos, *et al*.2017). Management system (feeding system, ventilation and lighting system, health programs, etc.) in current study significantly affect the surface area, shell weight, shell index and specific gravity. And obvious effect of housing system on surface area, shell weight, shell index and specific gravity was reported by Clerici, *et al*. (2006). In spite of the higher values of the external egg characteristic of birds kept under semi close system compared to those kept under traditional system the egg weight, egg volume and shell thickness showed no significant deferent(Clerici, *et al*.2006., Ledvinka, *et al*. 2010., Kühn *et al*. 2014., Lordelo *et al*. 2017 and Sokotowicz, *et al*. 2018) (table 1). The result revealed significant (P<0.01) effect of breed on albumen height, albumen weight, Haugh unit, yolk weight, yolk- albumen (%) (table 2), which agree with (Ahn, *et al*.1997., Zita, *et al*. 2008., Ledvinka, *et al*. 2010., Markos, *et al*. 2017, and Sokotowicz, *et al*. 2018). The yolk weight in Hisex heaver than Baladi, which agree with Ledvinka, *et at*., (2010) who reported that the yolk was the main component of the egg which enlarged egg weight. The study also presented a significant different of management on albumen height, albumen weight, Haugh unit, yolk weight, yolk- albumen(%), (Englmaierova ,*et al*. 2014, and Sokotowicz *et al*. 2018). However the management system has no significant effect on yolk volume.

Conclusion

Breed and management had significant effect on egg weight, egg volume, surface area, shell weight, shell thickness, shell index and specific gravity, Hisex white produced higher values compared to Sudanese Baladi. Significant effect of breed and management on some extermal and internal physical egg characteristic, heavier yolk weight produced by Hisex white than Baladi.

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Table (1): Effect of breed and management on some external physical egg characteristics

Main factor		Egg weight (g)	Egg volume (cm^3)	Surface area (cm^2)	Shell weight (g)	Shell thickness (mm)	Shell index	Specific gravity
Breed[1]	Hisex	52.03±4.0	51.32±4.8	66.95±34	7.57±0.9	26.72±3.5	9.18±3.1	1.01±00
	Baladi	43.09±2.5	40.30±4.9	51.60±1.2	5.33±0.7	24.52±2.7	8.90±2.6	0.93±0.1
	Sig.	**	**	**	**	**	NS	**
Management[2]		52.03±4.0	51.32	66.95 ±	7.57 ±	26.72 ± 3.5	9.18 ±	1.01 ±
Traditional			±4.8	3.4	0.9		3.1	0.0
	Semi-closed	53.45 ± 5.6	52.50 ± 6.5	68.96 ± 5.0	8.01 ± 0.9	27.77 ± 3.3	10.06 ±0.8	1.03 ± 0.0
	Sig.	NS	NS	*	**	NS	*	*

Table (2): Effect of breed and

Main factor		Albumen height	Albumen weight(g)	Haugh unit	Yolk weight (g)	Yolk volume (ml)	Yolk-albumen (%)
Breed[1]	Hisex	7.12 ± 1.3	30.13 ± 2.8	86.21 ± 8.0	14.17 ± 1.6	13.49 ± 1.8	48.77 ± 6.4
	Baladi	4.16 ± 0.7	25.53 ±4.1	73.53±10.9	12.81 ± 1.8	12.33 ± 1.8	58.52 ± 6.3
	Sig.	**	**	**	**	**	**
Management[2] Traditional		7.12 ± 1.3	30.13 ± 3.6	86.21 ± 8.0	14.17 ± 1.6	13.49 ±1.8	48.77 ± 6.4
	Semi close	5.02 ± 1.1	35.32 ± 6.6	71.56± 9.4	13.69 ± 1.4	13.45 ± 1.7	43.58 ± 6.7
	Sig.	**	**	**	*	NS	**

أثر السلالة ونظام التربية علي بعض الخصائص الفيزيائية الخارجية والداخلية للبيضة

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المستخلص

هدف البحث دراسة أثر سلالة (الهايسكس والبلدي السوداني) و نظام الاسكان (شبه المغلق والتقليدي) علي بعض الخصائص الخارجية (وزن البيضة, جم البيضة, محيط السطح, وزن القشرة, سمك القشرة, مؤشر القشرة والثقل النوعي) والداخلية (ارتفاع البياض ، وزن البياض ، وحدة الهوف ، وزن الصفار ، حجم الصفار ونسبة الصفار الي البياض). عدد (204) جمعت لهذه الدراسة عدد 136 بيضة جمعت من هجين هايسكس الابيض (68 من دجاج بياض مربي في نظام تربية تقليدي و68 بيضة من دجاج بياض مربي في نظام شبه مغلق) بينما تم جمع عدد 68 بيضة من قطيع بلدي سوداني مربي في نظام تقليدي . تم استخدام ميزان كهربائي رقمي , فيرنير كاليبر ومعادلات استخدمت لتحديد القياسات. اظهرت الدراسة ان السلالة لها اثر معنوي علي وزن البيضة ، حجم البيضة ، محيط البيضة ، وزن القشرة ، سمك القشرة ، الثقل النوعي ومؤشرة القشرة. الجودة الخارجية للبيضة قيمها اعلي في الهايسكس مقارنة بالبلدي السوداني ، في المقابل نظام التربية له اثر معنوي علي محيط البيضة ، وزن القشرة ، مؤشر القشرة والثقل النوعي ماعدا وزن البيضة ، حجم البيضة ، وسمك البيضة . ايضا الدراسة اظهرت اثر معنوي للسلالة علي ارتفاع البياض ، وزن البياض ، وحدة الهوف ، وزن الصفار ، حجم الصفار ، ونسبة الصفار الي البياض . في حين ان نظام التربية له اثر معنوي علي ارتفاع البياض ، وزن البياض ، وحدة الهوف ، وزن الصفار ونسبة الصفار الي البياض إلا انه ليس له اثر علي حجم الصفار.