Effect of Housing System and Season on Egg Quality in laying hens in Khartoum state

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ABSTRACT:

This study was conducted to assess the effect of housing system and season on egg quality in Khartoum Stateduring the period of January – August.Towgroceries were selected randomly from each of the 3 localities. One egg tray from closed and one from open housing system were randomly selected from each grocery twice per month for six months. Five eggs were selected randomly from each tray for egg quality investigation, using the cluster method. The collected data divided into 3 seasons to study housing and season effects. Study showed significant effect of housing on (Egg Weight) ($P < 0.1$) , (Yolk Color) ($P < 0.01$) and (NS) on (Egg Shape), (Shell Thickness), (Yolk Index) and (Haugh Unit). Season showed significant effect on (Egg Weight), (Egg Shape), (Shell Thickness) and (Hough Unit) each at ($P<0.01$) and (Yolk Color) at ($P<0.05$). Wet season showed numerically the highest level over winter and dry summer for all parameters studied. Closed housing system also showed the better results for all parameters studied over the opened system.

Keywords: Housing, Season, Marketing Channel, Egg quality

INTRODUCTION:

Many genetic and environmental factors affect egg quality where housing system and season are ones on which few limited studies have been conducted. Alternative systems have become more important and the effect of these systems on egg quality parameters need to be determined **[1].**However there are limited studies evaluating differences among housing systems for egg quality traits across a production cycle **[2], [3].**As early as 1936 lorenz and Almquist noted seasonal variations of egg quality being better in winter and spring than in summer showing highest internal quality. Shell thickness was significantly lower in summer and specific gravity was significantly higher in young birds and during the cool season. Age and season significantly

affected shell weight and percentage and that during spring and summer months both shell weight and percentage decreased**[4].**

Indicated that high temperature limited the productive performance irrespective of kept intensively or extensively and that climate is one of the primary factors that affect egg production and quality**[5].**Confirmed that feed intake and feed gain ratio were lower in birds on 34 ˚C than on 21 ˚C irrespective of the breed or strain of chicken[6]. A study ofegg quality of different chicken genotypes in summer and winter found egg quality traits of egg color, yolk width and weight, albumen dry matter weight tended to increase in winter than summer. Eggs contained significantly high albumen dry matter weight; tend to increase in winter than summer. Eggs contained significantly high albumen width and height, yolk, egg shell weight and thickness, dry matter weight and yolk percentage in winter than summer. High temperature decreased yolk albumen and shell weight, shell thickness and specific gravity but increased HaughUnit (HU) rating**[7].** A study ofeffect of age and season on egg quality traits in Nigeria concluded that egg quality trait were better during early wet summer which favored the measured variables**[8-9].**A study found that eggshell abnormalities due to mycoplasma synovia appeared to be more in summer than other seasons with no effect on egg internal quality**[10].**A study on the effect of summer and winter season on egg abnormalities found significant differences due to season being higher in summer thanwinter though classified as minor abnormalities**[11].**Stated that season. Hen breed flock age and flock diseases, vaccination status interact to affect egg safety and quality in addition to housing system. They added that understanding of these different effects is prudent before any large scale move to an alternative housing system is undertaken.Funding for research into various housing programs and their effects on egg safetyquality only recently, has been made available in the European Union**[12].** Studying effect of open and closed system on egg production and quality found significant reduction in feed intake, egg production, shell thickness and (HU) inlayers reared in open than closed house and with increasing time egg production and egg weight increased in both housing systems**[13]. [14].**Compared initial quality of egg and hens of the same strain under intensive andextensive systems of management over 12 month period and found that change of quality due to maturing of pullet were small compared with seasonal effects as different measures of quality were differently affected by season in favor of cool months**[15].**

on the impact of different housing systems and age of layers on egg quality characteristics found highest egg weight, yolk weight albumen weight, shell weight, albumen index, yolk index Haugh Unit, shape index were all significant ($P < 0.001$) in conventional and enriched cages .They concluded that eggs on free range system were better in overall quality than eggs from both cage systems**[16].**Concluded that there was no general consensus demonstrating superiorityof one housing system over another regarding food safety and egg quality as many factors interact to affect egg quality**[12].**

This study was designed and conducted to investigate in variations ofegg quality throughout the year concentrating on housing system and season of the year and theirinteraction

MATERIALS AND METHODS:

To study effect of housing system and season on egg quality 2 groceries were selected randomly from each of the three localities of Khartoum State on each of day one and day 15 of every month for the six months of the study. From each grocery one tray was from open and one from a closed housing source as identified by the grocery owner. From each of these trays five eggs were randomly selected using the number method. These eggs were used for the quality study. All the data of the six month was used collectively for studying the housing effect.

The same data and months were arranged into 3 seasons January- Februaryas winter, April –May dry summer, and July – August as wet summer.Statistically the sampling followed the cluster method in a (CRBD) Complete Randomized Block Design and analyzed by ANOVAusingSPSS Version (16).

Parameters studied were:

- Egg weight (EW) in grams (g) using a 0.1 decimal sensitive balance.
- Shell thickness (ST) using a micrometer.
- Egg shape (ES) by the formula $\frac{\text{Egg Width}}{\text{Egg Length}} \text{ X } 100$
- Hough Unit (HU) using a slide Rule (Kaw Company).
- Yolk Index (YI) by the formula $\frac{\text{Yolk Height (Millimeter mm)}}{\text{Yolk Width Diameter}} \text{ X } 100$
- Yolk Color (YC) by Color Fan 1 -15 degrees by Roch Company, DSM.

In Sudanreports showed that the average temperature for the winter months range between 16 to 33 ˚C, for dry summer between 23 to 42 ˚C and for the wet summer 25 to 38 ˚C with an average of 31˚C[17].

RESULTS:

Table (1): Effect of open housing system on egg quality:

Parameter / Month	Egg weight (g)	Egg Shape %	Egg shell thickness (mm)	Yolk Index	Haugh Unit(HU)	Yolk Color
January	44.6	76.2	o.32	o.33	75.96	5.52
February	47.4	75.2	o.31	o.33	70.60	6.56
April	40.68	74.7	o.31	o.33	71.80	5.20
May	56.68	75.9	o.31	o.31	71.60	5.68
July	51.20	76.4	o.31	o.33	71.40	6.12
August	49.40	76	o.32	o.32	74.40	5.76
Total Average	51.29	75.74	o.32	o.33	73.08	5.51

Yolk color: YolkcolorFan - DSM

Hu: EggQuality Slide Rule - USDA

Table (2): Effect of closed housing system on egg quality:

Parameter / Month	Egg weight (g)	Egg Shape %	Egg shell thickness (mm)	Yolk Index	Haugh Unit(HU)	Yolk Colour
January	57.80	75.4	o.32	o.31	75.76	6.48
February	55.71	75.1	o.33	o.33	72.89	6.56
April	56.16	74.1	o.31	o.32	76.80	5.20
May	60.20	73.6	o.34	o.33	79.OO	7.12
July	59.20	74.9	o.34	o.35	73.92	5.08
August	56.16	74	o.35	o.33	76.64	6.80
Total Average	57.75	74.52	o.33	o.33	72.42	6.49

Yolk color: Yolkcolor Fan - DSM

Hu: Egg Quality Slide Rule - USDA

Table (3): Statistical Analysis of the effect of housing system and season on some egg quality Parameters:

Factors Housing System	weight (g)	Egg Shape Egg %	Egg shell thickness (mm)	Yolk Index	Haugh Unit (Hu)	Yolk Color
Open	51.29	75.74	32.16	o.33	72.42	5.51
Close	57.75	74.52	32.62	o.33	73.08	6.49
SE	0.541	0.772	0.118	0.382	0.13	0.217
Significance	**	NS	NS	NS	NS	**
Season						
Winter	53.15^{b}	71.10^{c}	32.69^{b}	o.34	72.79^{b}	5.74^{b}
Dry Summer	53.50^{b}	73.02^{b}	31.25^{c}	o.33	71.49^{c}	5.14^{ab}
Wet Summer	56.91^{a}	79.09^{a}	33.28^{a}	o.33	73.97^{a}	6.08
SE	0.663	0.776	0.144	0.468	0.16	0.266
Significance	**	**	**	NS	**	*
System X Season						
SE	0.937	0.976	0.204	0.662	0.226	0.376
Significance	**	NS	*	NS	NS	NS

N= 30

***=** significantdifferences at P < 0.05, **= significant differences P<0.01, NS = No significantdifferences.

Different Superscript letters within the same row mean significant differences at P < 0.05

DISCUSSION:

The study of the impact of different housing systems on egg safety and quality.

Stated that many factors act and interact to affect egg quality**[12].** This statement can be supported by some studies including seasonal and chicken maturity egg effect.Study ofchicken genotype and season**[15]**and**[7].**Also study of breed, strain, age and season in derived savanna zone of Nigeria**[6]**and**[9].**Other study of housing and age and in this study housing and season**[16].**

On the effect of housing the overall result of this study showed significant effect on egg weight and yolk color at (P< 0.01) but all the numerical figures for the closed system were better than the open forall parameters studied .Possible explanation could be attributed to better bioclimatic control that meets the bird biological needs and by better energy utilization. Results agreed with studies in Iraq and Nigeria in which found decrease in shell thickness and HaughUnit (HU) in open houses**[14]**and **[9].**And with similarto that found better egg weight for closed than open houses for all months studied**[15].**

On the effect of season on egg quality many workers stated that best egg quality was obtained in the cool months of spring and winter **[12]** and [4]. In this study the best quality parameters were obtained in wet summer which agrees with the finding in Nigeria**[9].**Thisfinding indicates temperature humidity effect an area that needs more in depth study.Shell thickness yolk index and HU showed the lowest numerical values in the dry summer which agrees with**[4], [15],[7]** and**[9].**This indicates temperature effect as was noted by **[18]**and **[19].**

Season effect showed high significance for egg weight, shape, shell thickness, HU at (P< 0.01).Yolk color at (p<0.05) and no significance for yolk index. Wet summer showed the best numerical values for all parameters studied.

Housing system X season interaction showed high significance for egg weight (P< 0.01) andshell thickness at (P< 0.05) supporting the move to closed housing system (for the open).

Comparing the numerical data with other findings and standards the study findings showed that the average egg weight for all months and seasons was 57.75g which is placed an medium size and was 51.29g for the open system which lies in the small size according to the below references.

In African countries 65+ g is considered large size 55 -65 g. as medium and 45 -55 g as small**[20]**.In Sudan 60-64 g is considered as large 55 – 59 g. as medium, 50-54 g. as under

average and 40 g as small size**[21]**.. This same reference puts HU at 72 units for high quality eggs and for first class fresh egg at 60-71 units meanwhile another study puts acceptable HU at more than75**[22]**.

In study HU ranged between 71 – 76 units for open system and 72-79 for the closed. For egg shape the figure ranged between 74-75 for the closed and 74-76% for the open system with no significant difference. Most references stated that 74 % is the acceptable number for the proper oval egg shape **[23].**The same reference puts yolk index at 0.42-0.49 and shell thickness at 0.31 mm.

In the study yolk index ranged between 0.31-0.32 mm for the open system and 0.31 – 0.35 for the closed indicating possible storage and time -duration - effect in the groceries studied. Shell thickness was better in the closed than the open system. yolk color using(Color Fan DSM) divided in to 1-15 degree was found at the range of 5.2- 6.6 for the open house and 5.2 – 7.1 for the closed system indicating pale yellow color for both systems though better for the closed system .This could be attributed to deficiency of yolk color pigments as a nutritional problem in both housing systems and seasons. Color preference varies with individual customers and various countries. New Island puts color preference at 13 degree**[24]**.

CONCLUSION:

The study concludes that both housing system and season have direct effect on egg quality. The study recommends more drive to the closed system for better egg quality specially egg size. Asat present more than 80 % of table eggs marketed in the Sudan come from the open unit farming system. This is in addition to that the international trend is marketing eggs by quality and not just by quantity as is practiced now in the Sudan which strengthens the move to better egg quality production.

REFERENCES:

[1]Van Den Brand, H., Parmenter, H.R, Kamap, B. (2004). Effects of housing system (outdoor vs. cages) and age of laying hens on egg characteristics, Brit. Poult Sci. 45: 745-752.

[2]Tactacan, G.B., Guenter, W.,lewis, N.I. Rodrigues- Lecompte, J.C., House, J.D. (2009). Performance and Welfare of laying hens in conventional and enriched cages .Poult,Sci, 88: 698-707.

[3]Wall, H. (2011). Production, Performance and proportion of nest eggs in layer hybrid housed in different designs of farms of furnished cages.Poult.Sci, 90: 2153-2161.

[4]1zat,A.L., Gardner, D., Mellor.B. (1985). Effect of age of bird and season of the year on egg quality 1.shell quality poult .Sci 64(10)1900-1906.

[5]Graces, A. , Casey, N.H. , Norst, P. (2001). Productive Performance of naked neek, frizzle and dwarf of laying hens under various natural climates and two nutritional treatments. South African J. of Anim. Sci. , 31(3): 174-180

[6] Lu, J.W. and Zhang, H. (2007). Effect of chronic heat exposure on fat deposition and meat quality in two genetic types of chicken,.poult Sci. 86: 1059-1064.

[7] Islam, M.A, Balbui., S.M., Seeland, G., Islam A.B.M.M. (2001). Egg quality of different chicken genotypes in summer and winter.Pakistan J. of Biological Sciences 4:1411-1414.

[8] Usayran, N.,Farran, M.T., Awadallah, H.H.O. Al-Hawi, R. J. A. ,Ashkarian,V.M. (2001). Effect of added dietary fat and phosphorus on the performance and egg quality of laying hens subjected to a constant high environmental temperature. Poult. Sci. 80:1695-1701.

[9] Ojedupo, L.O. (2013). Effect of age and season on egg quality traits of ISA brown layer strain reared in derived savanna zone of Nigeria. Transitional J. of Sci. and Tech.3(7) 48-60.

[10] Brandao. M.D.M., Santos. F.F., Machado, L.S,Verinaud, M.S., Oliveraj, J.M Soares, N.M,Nascimento, E.R, Perejra, V.L.A., (2014). The effect of egg shell apex abnormalities on table egg quality during storage in 2 seasons of the year.Poult.Sci. 93: 2657 – 2662.

[11] Faris, A. A.,Al Shadeedi,5.M.J.(2018). Effectofsummer and winter seasons on egg abnormalities ofoutdoor rearing some native chikenstrains. J. Bio. Env.Sci. 12(3)220- 225.

[12] Holt, P.S, Davies, R.H., Dewuff, J., Gast. R.K, Huwe., J.K., Jones, D.R., (2011). The impact of different housing systems on egg safety and quality.Poult. Sci. 90:25-262.

[13] Safe house Project (2010). Project Short Presentation Summery. – Europeon Union (EU).

[14] Al Hassani ,D.H.,ALJanabi,A,S.,AL.Joubori,A.S. (1989). Effect of opened or closed system on productivity and egg quality of layers in Iraq. J. of Agricultural Sciences 20(1): 88 – 102.

[15] Jones K.b., Houston T.W,Hrries. J.M (1961). Studies on egg quality effect of certain Poultryhousing systems, age of bird and season. J. Science of Food and Agriculture (12) (5:):Abst.1.

[16] Dikmen, B.Y., lper, A., Sahan, O., Soz_co, A. Bycan, SC. (2017). Impact of different housing systems and age of layers on egg quality characteristics.Turk.J.Vet. Anim. Sci. 41: 77-84.

[17]Sudan Meteorological Department Reports – 2017.

[18] Smith, A.J. (2005). Some effect of high environmental temperature on productivity of laying hens – a review. J. Tropical Animal Health and Production 5(4): 259 – 271.

[19] Rozenboin, I.E. ,Tako,O.G., Proudman, J.A. Uni, Z (2007). The effect of heat stress on ovarian function of laying hens.Poult. Sci. 86:1760-1765.

[20]FAO (Food and Agriculture Organization).(2003). Egg marketing. A Guide for the Production and Sale of Eggs. Agricultural services Bulletin, 150 Rome - Italy.

[21]Sudan Standards Metorogical Organization (SSMO). Table Eggs. 751-2007.

[22] Bertechini, A.G. and Mazzuc, H. (2013). The table egg : a review. Ciene. agrotec. 37 (2) 1 – 10.

[23] Kamel, F.N. (2005). The Egg.Bustan Al- Marifa Library, Al Exandvia, UAR

[24] Gerber, N, (2012), Factors affecting egg quality in the commercial laying hen. Egg producers of New Zealand (Inc)Poultry Industry Association of New Zealand . 1 -28.