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Effect of Broiler Breeders Age of ROSS 308 on Eggshell Conductance throughout Production Period

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***Abstract*:** This experiment was conducted at University of Anbar during 2020-2021to observed the effect of aging of the broiler breeders on the gas conductance of the egg shell by observing the age of breeders for 11 weeks starting from the age of 28 up to 41 weeks. This study uses 120 hatching egg from broiler breeders fields of Ross 308 of Al-Manar company for poultry production in Diyala. There was significant increase in the weight of eggs at the age of 38 and 40, accompanied with a change in the measured gas conductance (G1) were decreased in the early age of the breeders (28-34 weeks) but increased in the age 36-41 weeks. The aging processes of the breeders lead to a decrease in the conductance constant (K) value, and the gas conductance of the egg shell and an increase in gas conductance efficiency.

***Keywords*:** Conductance, Conductance constant, Permeability, Broiler breeder age, Eggshell

The age of broiler breeders Ross 308 affects the values of standard gas conductance for hatching eggshells due to the change occurred in the average of egg weight which affects the gas conductance of egg shell (Nasri et al a 2020) . Sahan et al (2020) observed that there is an increase in the gas conductance from 11.00 to 11.99 mg/day/torr at the ages of 28 and 40 weeks with egg weights of 57.43 and 58.11g, respectively. Wesam et al (2015) also observed change in gas conductance throughout the producing cycles of eggs and increased in the first half of the cycle then it became moderate and stable afterwards. Nangsuay et al (2016) did not notice any changes in the values of eggshell conductance for the eggs of the breeder flocks, young ones and old ones, which was 4.18 and 4.48 mg/hr/Kilopascal at the ages 29 and 54 weeks, respectively. Salamon (2020) reported change in gas conductance as the breeders grow older and this change is attributed to the change in the thickness of the shell and the cuticle layer, because the rate of fluid loss from the egg increases with the decrease in the thickness of the shell and cuticle layer because the total shell deposition after the first three months of the egg-laying period remains fairly constant while the eggs continue to increase in size resulting in a thinner shell (Gaulhanone et al 2012). The study was conceited to observed the effect of aging of the broiler breeders on the gas conductance of the egg shell.

MATERIAL AND METHODS

This experiment was conducted at University of Anbar during the period (November 20, 2020 to March 9, 2021) to show the effect of progress in breeders age on the values of gas conductance of the eggshell by following the age of breeders for 11 weeks and over 14 weeks from the age of 28 and until the age of 41 weeks.

Breeder flock: Eggs from Ross 308 broiler breeder flock were used at 28, 29, 30, 32, 33, 34, 36, 37, 38, 40 and 41 weeks of age.

Egg collection and storage: The 120 hatching eggs were collected from the fields of broiler breeders, ROSS 308, affiliated to Al-Manar Poultry Production Company, in, Jizan Al-Imam of Diyala Governorate and were distributed in the form of 90 eggs 10 eggs/age of 28-29-30-32-33-34-36-37-38 weeks and 30 eggs of ages 40-41 weeks. All eggs were numbered and got their weight recorded, then the eggs were placed inside the dryer at a temperature of 25°C for 5 days, while observing the changes occurring on eggs weight by weighing the eggs on a daily basis at 24.

Eggshell water vapor conductance: The conductance was measured at 25°C, according to Visschedijk (1982) by placing the eggs inside the dryer and adding white silica gel that absorbs humidity at the base of the dryer with a rate of 5 grams for each egg. The G_{H2O} (G1) (mL STPD/day/mm Hg) values of the eggs were calculated according to the procedures of Peebles and McDaniel (2004) and G_{H2O} (G3) (mL STPD/day/mm Hg) according to Ar et al (1974). G_{H2O} (G5) (mL STPD/day/mm Hg) of the eggs was estimated according Hoyt (1980) . The specific G_{H2O} (gH2O -g2 , g5 , g6) was adjusted to 100 g on egg weight basis (mg of H_2O/d/Torr/100

g) as per Ar et al (1974) and Ar and Rahn (1978) modified by Pulikanti et al (2012). The G_{H2O} conductance constants (K_{H2O}) of the eggs were calculated using the procedures suggested by Christensen et al (2011).

Statistical analysis: The analysis was done by using General Linear Model (GLM) procedure of statistical software package SAS version 9.1 (SAS 2004), P values less than 0.05, 0.01 and 0.001 were considered to be significant for the main effect and results as presented as mean/ SEM.

RESULTS AND DISCUSSION

There was significant increase in egg weight over a period of 14 weeks through a follow-up of 11 weeks of breeders' age (28 to 41 weeks), especially at the age of 38 and 40 weeks (62.08 and 67.25 g, respectively), where the weight of the egg increased at this age and was accompanied by a change in the measured gas conductance values (G1). This decreased at the beginning of breeders age (28 -34 weeks) (7.78 - 8.35 - 7.78 - 7.09 - 8.10 - 5.83 ml STPD /day/ mm Hg) but increased at the age of (36-41 weeks) (Table 1). Lukic et al (2020) and Nasri et al (2020) also observed the average weight increase of egg with the aging. This increase in the weight of the egg due to the increase in the weight of the yolk and albumin of egg. The progression in the age of the breeders also led to a significant decrease in the conductance constant (K) (egg gm /G1/day) (Table 2). The higher egg weight was due to greater the egg's ability to retain internal fluids so the daily loss constant is decreased (Christensen et al 2005). The conductance constant depends in its calculation on the change in the weight of the egg (g) as a result of the water vapor lost by the egg. The progression in the age of the breeders also led to a significant decrease in permeability (μm/day/Torr/cm^2) as a result of the increase in egg weight and size, which leads to an increase in the surface area of the egg shell because the permeability reflects the conductance amount per square cm of surface area (Table 2). The gas conductance efficiency helps in setting a standard for the efficiency of the conductance. The progression in the age of the breeders led to a significant increase in the conductance efficiency which means that the conductance measured by the measurement method (G1) do not approach the conductance values calculated using the equation Ar (1974), which is symbolized by G3, and do not approach the conductance values calculated by the method of Hoyt equation (1980), which is symbolized by G5 because the measured method G1 was the most accurate in determining the gas conductance for each egg, based on the difference during five days in egg weight, temperatures and atmospheric pressure (Table 3). The calculated method G3 and G5 was based on the average weight of the egg, the differences in weights as a result of storage and the natural pressure rate at sea level are not included in the calculation. The same results were achieved when calculating the gas conductance values for g2, g4 and g6 by returning the egg weight per 100 gm (Table 1).

Table 1. Gas conductance characteristics of hatching eggs shells during 14 weeks of breeders' age spanning from 28 to 41 weeks at 25ºC inside the desiccator

Breeder age (week)[1]	Egg weight (gm)[2]	G1	G2	G3	G4	G5	G6
28	54.66 ^{c}	7.78 ^{b}	14.26^{bc}	12.18 ^{c}	22.28 ^{a}	12.96 ^{c}	23.72 ^{a}
29	56.02 ^{c}	8.35 ^{b}	14.90 ^{bc}	12.41 ^{c}	22.15 ^{a}	13.23 ^{c}	23.61 ^{a}
30	55.61 ^{c}	7.78 ^{b}	14.00^{bc}	12.34 ^{c}	22.19 ^{a}	13.15 ^{c}	23.64 ^{a}
32	54.85 ^{c}	7.09^{bc}	12.94^{cd}	12.21 ^{c}	22.26 ^{a}	13.00 ^{c}	23.70 ^{a}
33	56.54 ^{c}	8.10 ^{b}	14.32^{bc}	12.50 ^{c}	22.11 ^{a}	13.33 ^{c}	23.58 ^{a}
34	55.04 ^{c}	5.83^{cd}	10.58^{de}	12.24 ^{c}	22.24 ^{a}	13.04 ^{c}	23.69 ^{a}
36	54.51 ^{c}	11.38^{a}	20.95 ^{a}	12.15 ^{c}	22.29 ^{a}	12.93 ^{c}	23.72 ^{a}
37	55.98 ^{c}	8.66 ^{b}	15.46^{bc}	12.40 ^{c}	22.16 ^{a}	13.22 ^{c}	23.62 ^{a}
38	62.08 ^{ab}	10.62^{a}	17.04 ^{b}	13.45^{ab}	21.66^{bc}	14.40^{ab}	23.20^{bc}
40	67.25 ^{a}	4.30 ^{d}	6.53 ^{f}	14.29 ^{a}	21.35 ^{c}	15.37 ^{a}	22.94 ^{c}
41	57.64 ^{bc}	4.44 ^{d}	7.71 ^{ef}	12.69b^{c}	22.02^{ab}	13.54^{bc}	23.50^{ab}
Probability	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001	0.0001
Average	58.00	6.83	11.91	12.74	22.01	13.61	23.50
SEM	0.6396	0.2553	0.4749	0.1074	0.0476	0.1224	0.0397

[1] Broiler Breeder flock at 28, 29, 30, 32, 33, 34, 36, 37, 38, 40 and 41 weeks of age.
[2] Egg weight during breeder age from 28 to 41 weeks.

Table 2. Characteristics of gas conductance constant, permeability, and conductance efficiency of hatching eggshells during 14 weeks of breeders' age panning from 28 to 41 weeks at 25ºC inside the desiccator

Breeder age (week)[1]	Egg weight (gm)[2]	Conductance constant (G1/day/Egg gm)	Permeability µm/day/Torr/cm^2))	Conductance[1] efficiency	Conductance[2] efficiency
28	54.66 ^{c}	0.712 ^{bc}	114.00 ^{c}	58.80 ^{bc}	69.06 ^{bc}
29	56.02 ^{c}	0.746 ^{bc}	120.22 ^{bc}	52.02 ^{bc}	62.03 ^{bc}
30	55.61 ^{c}	0.700 ^{bc}	112.60 ^{c}	60.46 ^{bc}	70.96 ^{bc}
32	54.85 ^{c}	0.648 ^{cd}	103.61 ^{cd}	73.21 ^{bc}	84.42 ^{bc}
33	56.54 ^{c}	0.714 ^{bc}	115.92 ^{c}	65.47 ^{bc}	76.44 ^{bc}
34	55.04 ^{c}	0.527 ^{de}	84.85 ^{d}	112.46 ^{b}	126.24 ^{b}
36	54.51 ^{c}	1.046 ^{a}	167.20 ^{a}	6.69 ^{c}	13.54 ^{c}
37	55.98 ^{c}	0.770 ^{bc}	124.74 ^{bc}	44.85 ^{bc}	54.37 ^{bc}
38	62.08 ^{ab}	0.853 ^{b}	142.48 ^{b}	31.68 ^{bc}	41.02 ^{bc}
40	67.25 ^{a}	0.326 ^{f}	55.51 ^{f}	278.43 ^{a}	306.88 ^{a}
41	57.64 ^{bc}	0.385 ^{ef}	62.75 ^{ef}	204.16 ^{a}	224.63 ^{a}
Probability	0.0001	0.0001	0.0001	0.0001	0.0001
General average	58.00	0.595	96.51	122.02	137.28
SEM	0.6396	0.0237	3.7576	12.0975	13.0259

[1] Broiler Breeder flock at 28, 29, 30, 32, 33, 34, 36, 37, 38, 40 and 41 weeks of age.
[2] Egg weight during breeder age from 28 to 41 weeks.

Table 3. Standard conductance characteristics of hatching eggshells measured by desiccator during 14 weeks from 28 to 41 weeks of age

Breeder age (week)	Egg weight (gm)	Average difference in weight loss for 96 hours (mg water vapor/day)	Average temperature (Celsius)	Temperature × Atmospheric pressure (Appendix)	Atmospheric pressure rate (torr)
28	54.67	144.13	24.35	22.922	763.863
29	56.02	152.97	24.14	22.648	764.463
30	55.61	143.70	24.45	22.922	761.463
Average	55.43	146.93	24.31	22.831	763.263
32	54.85	135.12	25.02	23.476	766.563
33	56.54	154.29	24.96	23.198	768.063
34	55.45	110.92	25.00	23.756	762.063
Average	55.48	133.44	24.99	23.477	765.563
36	54.51	216.67	25.00	23.756	765.513
37	55.98	165.00	25.00	23.756	765.630
38	62.08	202.22	25.00	23.756	763.863
Average	57.52	194.63	25.00	23.756	765.002
40	67.25	81.96	25.50	24.617	759.062
41	57.64	215.26	25.60	24.617	757.712
Average	62.445	148.61	25.55	24.617	758.387

CONCLUSION

The qualities and characteristics of gas conductance of the egg shell represented by conductance, conductance constant, conductance efficiency and gas permeability change according to the ages of broiler breeders due to the aging process and the change of egg production cycle.

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