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CORRELATION BETWEEN EGG QUALITY PARAMETERS OF WILD GUINEA FOWL *NUMIDA MELEAGRIS* SOURCED FROM THREE MARKETS IN OGUN STATE, NIGERIA

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ABSTRACT

The potential of Wild Guinea fowl for domestication is still not totally exploited as there are needs for improved variability. This study was done in order to analyze egg features of wild Guinea fowl, *Numida meleagris*. A total of 27 eggs were obtained from three different markets in Ogun state and they were assessed for both external and internal features. Highest values of Haugh unit, albumen width, albumen height and egg shape index of 89.28%, 41.36mm, 6.34mm and 81.56% were recorded in eggs collected at Sabo market respectively. Highest egg width-37.57mm, egg weight- 34.38g and yolk diameter- 34.94mm were reported from eggs sourced from Itoku market while highest egg length-46.99mm, yolk height-16.29mm, yolk index-48.24% and albumen index- 24% were recorded in eggs obtained at Oke-Aje markets. Eggs internal and external parameters were not significantly different between the three markets ($p > 0.05$) but correlation between the parameters varied from positive to negative. Considerable association were found between egg shape index and egg's weight, albumen index and albumen width, weight of eggs and egg length, using Pearson's correlation coefficients with p-value of significance at 0.05 and 0.01. It is concluded that the wild eggs of guinea fowls sourced from the three markets had good quality traits in terms of the Haugh unit.

Keywords: Guinea fowl, *Numida meleagris*, egg quality, markets, correlation

INTRODUCTION

Guinea fowl, *Numida meleagris* is native to Africa and is the order Galliformes, and Numidae family. The species is mostly found in the Guinea Savanna vegetation zone within Nigeria (Baruwa and Solofuwe, 2016). In the country, two species of Guinea fowl; *Numida ptilorhycha* which is common in the Southern part, and *Numida meleagris* common in the Northern part with its continuous spread towards small-holder farming areas (Wanmi *et.al.,* 2017). The blue-wattled Guinea fowl, *Numida ptilorhycha*, is common to Zimbabwe besides a few other nations. It is a medium-sized guinea fowl that can weigh up to 1.8 kilograms when fully grown and has grayish blue feathers with white spots. The other is described docile *Numida meleagris* and is also known as the red wattled guinea fowl, is a bird that comes from West Africa (Binali and Kanengoni 1998). According to Embury (2001), the breeding season for guinea fowls typically runs between October and April in the Southern Hemisphere. A guinea fowl hen's age at first lay can range between 26 weeks and 32 weeks (Nwagu, 1997). Guinea fowl egg weight are usually taken into account when determining the conditions for incubation. The average Guinea fowl egg weight range is from 40g to 45g (Fani *et al.,* 2004). Moreki and Mothei (2013) reported significant high hatchability rate in medium-sized eggs between 39g and 42g than smaller eggs. Naadam and Issah (2012) reported egg weight of guinea fowl range from 31.4g to 31.8g with rates of hatchability from 72.8% to 73.6%. Binali and Kanengoni (1998) stated maximum of seven days for guinea fowl eggs storage at temperatures ranging from 10 to 18 degrees Celsius and a relative humidity of 70 to 80 percent, as their hatchability decreases rapidly with storage time.

Egg characteristics such as; weight of egg, width of egg, egg whites and egg yolk loads all play vital roles in bird reproduction because they contribute to what become quality of egg (Farooq *et al*., 2001). Egg parameters also impact bird's reproductive health and the development of their embryos (Onagbesan *et. al.,* 2007). For instance, the egg yolk, which accounts for approximately 33% of the egg's weight and has approximately 60 calories—three times more than the egg white—is full of nutrients. There are 2.7 grams of protein, 0.61 grams of carbohydrates, 210 milligrams of cholesterol and 4.51g of whole fat in a single large egg yolk that weighs 17 grams (Abdel-Aal *et. al*., 2013). Hence, egg yolk is used to make lecithin and egg oil for cosmetics and pharmaceuticals adding to being a source of food. Polar carotenoids accountable for the yellow color of yolk are Zeaxanthin and Lutein (Abdel-Aal and *et al.,* 2013).

Guinea fowl has several potentials that made it a highly sought for among all domesticated birds. Generally, there is an increasing demand for guinea fowl meat, especially in developing nations (Yildirim, 2012). This is because its potential for meat creation and significant number of eggs production. Meat from Guinea fowl poses fewer health risks and contains protein, vitamins, niacin, iron, with less fat (Mareko *et al.,* 2006). In addition, limitations against consumption of guinea fowl are not well known if such exist (Saina *et al.,* 2005). Unlike common poultry birds, Guinea fowl possesses greater resistance to common disease, has higher scavenging capability for insects and grains, harder egg shell and greater capacity to defend itself against predators (Dieng *et al.,* 1999). In some community, people keep Guinea fowl to keep snakes, mice, and ticks under control Cactus, (2001) while as helpful expansion to families some people keep Guinea fowl as "watch animals" around homesteads due to their sharp cry, tendency to shriek at the slightest provocation and excellent eye-sight (Wanmi *et al.,* 2016, Smith, 2000). Considered basic economic production factors of Guinea fowl are strains, incubation period, egg fertility, slaughter weight, age of onset of egg laying, seasonal egg production, hatchability of eggs, and keet survival rate (Somes, 1996; Nwagu and Alawa, 1995; Embury, 2001). With few attempts on domestication of Guinea fowl in Ogun state, there is still scarcity of logical data on egg boundaries and nature of wild Guinea fowls that can be used for upgrade domestication. For improvement on domestication of Guinea fowl, more information regarding the egg quality

characteristic of wild Guinea fowl eggs is required and this study provides logical data towards this.

MATERIALS AND METHODS

Study Area

This research was embarked upon in three distinct markets in three different cities; Ijebu-Ode, Abeokuta and Sagamu in Ogun State due to their significance for the sale of wild Guinea fowl eggs, popularity and scale for sales of traditional and customary materials. The three markets are Itoku in Abeokuta, Oke Aje in Ijebu-Ode and Sabo market in Sagamu. Ogun state covers 16,409.26 km^2 with human populace of 3.73 million. It is a Southwest geopolitical state bordered in the West by the Republic of Benin and bordered by Lagos State and the Atlantic Sea in the south. Towards the North, it is bordered by Oyo and Osun States while it shared border with Ondo State in the East (Aderoju, 2015). Rain forest covers the majority of Ogun State, with wooden savanna in the northwest. It has an average humidity of 80 to 90 percent and a temperature range of 270 to 320 degrees Celsius (Odufa *et al*., 2016). Itoku market in Abeokuta city is an ancient market in the hub of the indigenous Adire cottage industry and is located between 3°34'25"E and 7°15'67"N. Outstanding in the market is the segment committed to dealers in native spices and customary materials. Sabo market is at the center of Sagamu city in Ogun State and is situated between 6°83'25" N and 3°64'16" E. Oke Aje market is situated in Ijebu Ode and is one of the best local markets in Ogun State. It is located between 6°82'53" N and 3°93'03" E. The market is notable for selling individual traditional materials (Figure 1)

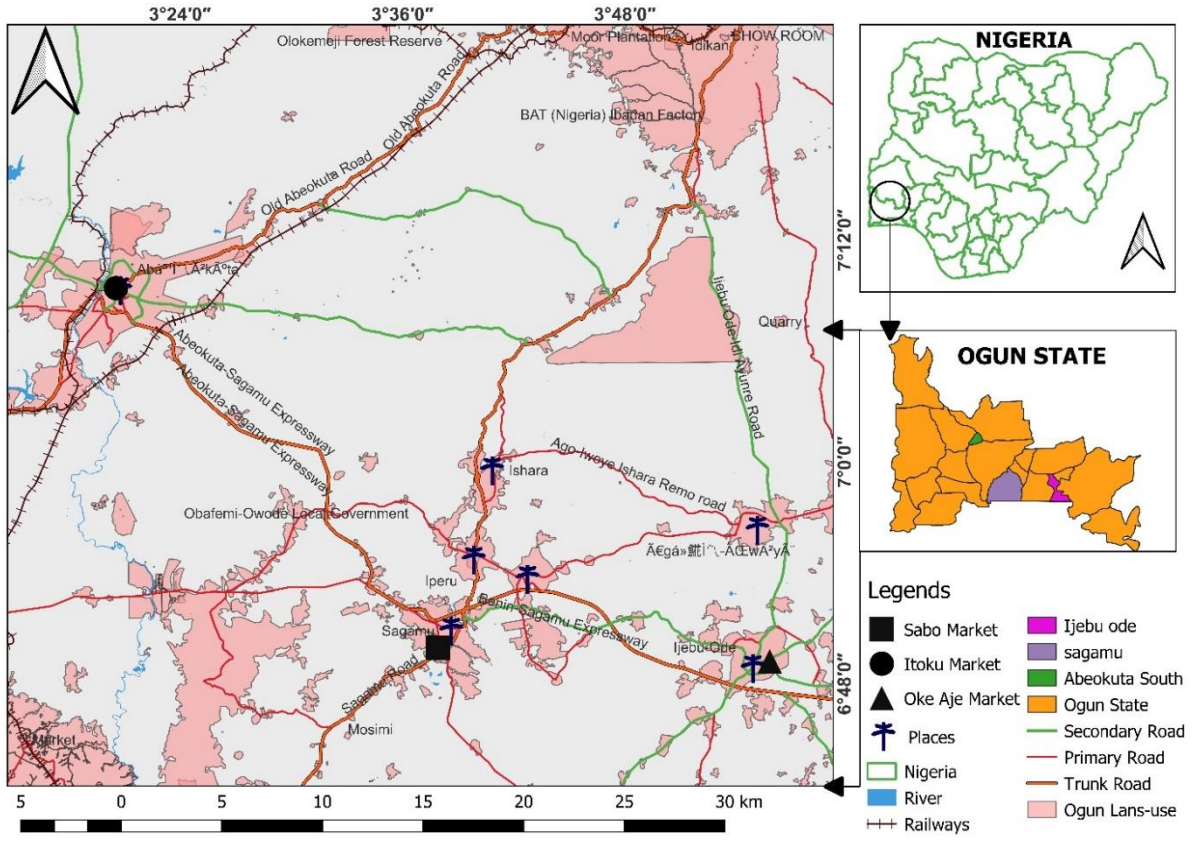

Figure 1: Map of the study area revealing the markets location

Data Collection

With the permission of the market head and leader, a reconnaissance survey of all wild Guinea fowl eggs vendors was carried out in each market from which three wild egg vendors were randomly selected. Three eggs were procured from each vendor, giving each city and market a total of nine eggs. In sum, a total of 27 eggs were obtained from the state, from three markets and nine wild Guinea fowl eggs vendors.

Measurement of Egg Parameters

Egg weight (g) was determined with aid of sensitive top-loading digital scale while measurement of width (mm) and length (mm) of egg was with digital calipers. The egg shape index = the proportion of egg width in relation to that of length of egg x 100 (Ukwu *et. al*., 2017). The yolk width (mm) and yolk height (mm) were recorded using vernier calipers. The albumin height (mm) measurement was taken at the highest point using a spherometer. Weight of the egg yolk to the nearest value (0.01g) was recorded with aid of sensitive top-loading digital scale. The estimation of yolk index is done using comparison of the proportion of yolk height and yolk width. Albumen weight = proportion of height of albumen to the length of albumen plus diameter of albumen / 2 x 100 (Duman *et al.*, 2016). According to Monira *et. al*., (2003) Haugh units (HU) were calculated as (HU) = 100 log10[H - 1.7Ew0.37+7.6], where H = height of albumen and EW = weight of egg. Yolk index (%) = [yolk height (mm) / (yolk diameter (mm)] x 100 (Ukwu *et. al*., 2017). Albumen index (%) = height of albumen divides by length of albumen (mm) plus diameter of albumen /2 × 100 Duman *et al.*, (2016) while egg shape index (%) is determined as width of egg / length of egg × 100 (Ukwu *et. al*., 2017).

Statistical Analysis

Information on egg morphometrics of wild Guinea fowl was analyzed using descriptive statistics such as mean and Pearson's correlation statistic to examine association among eggs' characteristics.

RESULTS AND DISCUSSION

Numerically, the highest value of egg width (37.57 mm) was recorded in eggs obtained at Itoku market, Abeokuta, and the least (37.27 mm) was recorded at Sabo market, Sagamu. These results were less to 37.89 (mm) egg width in the report of (Alkan *et. al*., 2013). Highest egg length of Wild Guinea Fowl (46.99 mm) was found in Oke-Aje market while the least (45.77 mm) was recorded in Sabo market, Sagamu. Values of egg length in this study was less in comparison with average means of 49.4 (mm) egg length in Wilkanowska and Kokoszyński, (2010) and Alkan *et. al*., (2013) reports.

The highest egg shape index (81.56%) of Guinea Fowl was from Sabo market followed by Itoku market (80.76%). The result was more than what was reported on Pearl helmeted Guinea fowl (Kgwatalala *et. al.,* 2013). Egg shape index recorded in this study were more than 78.8% and 76.60% respective results from previous studies (Mohsenpour *et. al.,* 2020; Alkan *et.al.,* 2013). Highest egg weight (34.38 g) was recorded in eggs obtained at Itoku market, Abeokuta market and the least egg length (32.06 g) was recorded in eggs obtained at Sabo market. These results were within the described range of 32g to 42g reported by Khairunnesa *et. al*., (2016) but were less than egg weight of Pearl and Lavender helmeted guinea fowl (Kgwatalala *et. al.,* 2013).

Highest yolk height of Wild Guinea Fowl (16.29 mm) was found in eggs from Oke-Aje market in Ijebu-Ode while the least (16.13 mm) was recorded in Sabo market. This result was more than outcomes stated (Mohsenpour *et. al.,* 2020 and Zelleke *et. al.,* 2020) but was less compared to what was previously reported (Vekić *et al*., 2018). The results further shows that the highest yolk diameter (34.94 mm) of Guinea Fowl egg was from Itoku market and the least (33.89 mm) was obtained at Oke-Aje market. Results of the yolk index revealed highest (48.24 %) in eggs obtained at Oke-Aje market and followed by the eggs obtained at Sabo market (47.03%). The result value was more than what was obtained in the past study (Mohsenpour *et. al.*, 2020 and Zelleke *et. al.,* 2020).

Highest albumen height of Wild Guinea Fowl eggs (6.49 mm) was found in eggs from Oke-Aje market while the least (5.78 mm) was recorded among eggs from Itoku market. The results in this stud were of more values than past results Kuzniacka *et. al.,* (2004) who reported value of 5.6 (mm). The results further shows that the highest albumen width (41.36 mm) of Guinea Fowl eggs was from Sabo market while the least (39.24 mm) was obtained at Itoku market. Moreso, the highest albumen index (24.01 %) was recorded in eggs obtained at Oke-Aje market and the least (22.65 %) was recorded in eggs from Itoku market. The highest haugh unit (89.28 %) was recorded in eggs procured from Sabo market Sagamu and the least (84.63 %) was recorded in eggs obtained from Itoku market Abeokuta. The results of Haugh unit (HU) in this value corroborates Ivanova *et al.* (2020) that reported range of 84.11 % - 91.93 %. It is evident with performance of Haugh unit as determinant of interior egg quality, the results from this study are found in the category AA of HU value above 72% when compared to Jones, (2009) publication (Table 1).

Table 1: Wild Guinea Fowl Egg Quality Parameters

Egg quality	Markets	Mean	Standard deviation
Egg Width (mm)	Itoku	37.57[a]	0.54
	Oke Aje	37.42 [a]	0.76
	Sabo	37.27 [a]	1.07
Egg length (mm)	Itoku	46.55[c]	1.08
	Oke Aje	46.99 [c]	1.56
	Sabo	45.77 [c]	2.52
Egg shape index (%)	Itoku	80.76[b]	2.71
	Oke Aje	76.69 [b]	2.02
	Sabo	81.56 [b]	3.03
Egg weight (g)	Itoku	34.38 [a]	2.00
	Oke Aje	34.23 [a]	3.72
	Sabo	32.06 [a]	8.32
Yolk height (mm)	Itoku	16.18 [b]	0.50
	Oke Aje	16.29 [b]	0.35
	Sabo	16.13 [b]	0.54
Yolk diameter (mm)	Itoku	34.94 [c]	1.62
	Oke Aje	33.89 [c]	1.89
	Sabo	34.29 [c]	1.51
Yolk index (%)	Itoku	46.34[b]	2.41
	Oke Aje	48.24 [b]	3.58
	Sabo	47.03 [b]	2.13
Albumen height (mm)	Itoku	5.78 [c]	0.68
	Oke Aje	6.49 [c]	0.65
	Sabo	6.34 [c]	0.99
Albumen width (mm)	Itoku	39.24 [a]	1.75

	Oke Aje	40.86 [a]	1.92
	Sabo	41.36 [a]	2.44
Albumen index (%)	Itoku	22.65[d]	2.51
	Oke Aje	24.01 [d]	2.22
	Sabo	23.39 [d]	3.25
Haugh unit (%)	Itoku	84.63[a]	4.56
	Oke Aje	88.96 [a]	3.66
	Sabo	89.28 [a]	4.95

Values with same superscripts are not significantly different. AH = albumen height, AI = albumen index, AW = albumen width, EL = egg length, ESI = egg shape index, EWt = egg weight, EW = egg width, HU = Haugh unit, YD = yolk diameter, YH = yolk height, YI = yolk index (Field work, 2022).

Correlation results from parameters of eggs sourced at Itoku market in Abeokuta varied from positive to negative. Albumen height and albumen index had positive correlation of 0.966 value which suggests that increase in albumen height caused increase in albumen index, and it corroborates findings of (Alkan *et al.,* 2013). Also, albumen height and haugh unit had positive correlation of 0.966 value while albumen index and haugh unit showed positive correlation of 0.933 value. It shows that rise in albumen height and index influence increase in haugh unit. This is a sign of very good traits of the eggs. Albumen height and egg weight had negative correlation -0.849 value.

Albumen index and egg weight had negative correlation value of 0-850. Negative correlation of -0.950 value was recorded among egg length and egg shape index while no linear correlation, -0.000 was found in egg shape index and egg length. A positive correlation with -0.917 value was recorded among haugh unit and egg weight. Egg width and yolk diameter correlation value was negative -0.783 while there was also negative correlation value of 0.850 between yolk diameter and yolk index. Negative correlations were implication that decrease in one lead to decrease in the other. (Table 2).

Similarly, significant correlation results varied from positive to negative between the parameters of eggs obtained at Oke-Aje market in Ijebu-Ode. Albumen height and albumen index had positive correlation of 0.883 value and a positive correlation value of 0.850 was also found among albumen height and egg weight. A positive correlation of 0.667 was observed within haugh unit and albumen index whereas egg shape index and egg length showed a negative correlation of -0.900 (Table 3).

Likewise, correlation results among the egg parameters at Sabo market in Sagamu diverse from positive to negative. Albumen index, haugh unit and albumen height showed positive correlations values of 0.904 and 0.787 respectively. The positive correlation recorded among albumen index and albumen height corroborates Alkan *et. al.,* (2013) reports. A very strong negative correlation value of -0.895 among albumen index and albumen width recorded compared to the weak negative correlation found by (Alkan *et. al.,* 2013). Also, between albumen index and haugh unit, a very strong positive correlation with 0.833 value was recorded. Albumen width and egg length had a negative correlation value of -0.686 which implies the smaller the albumen width the less the egg length.

Negative correlation results of -0.717 between the egg weight and egg shape index contradicted findings of (Kuzniacka *et al*., 2004). Positive correlation results of 0.750 between the egg length and egg width substantiates Alkan *et. al.,* (2013) reports. Egg length and egg weight with a positive correlation value of 0.700 validates Abanikanda *et. al*., (2007) report with correlation value of 0.78. Egg length and egg shape's negative correlation value of -0.717 indicates that decrease in egg length results in decrease in egg shape index. More so, the results of egg weight and yolk diameter positive correlation value of 0.700 signifies increase in volume in egg because an increase in egg weight caused an increase the volume of the yolk. Egg weight and yolk index had a negative correlated value of -0.700. Correlation results of yolk diameter and yolk height was negative (-0.833). Yolk diameter and yolk index also had a perfect negative correlation value of -1.000. All these negatives correlation suggest decrease in one trait leads to decrease in the other. Yolk height and yolk index had a positive correlated value of 0.833 which implies increase in the yolk height caused significant increase in yolk index (Table 4). It is concluded that the wild eggs of guinea fowls sourced from the three markets had good quality traits in relation to the albumen quality, egg weight traits and Haugh unit.

Table 2: Association between the Egg Parameters in Abeokuta Market

	AH_mm	AI_%	AW_mm	EL_mm	ESI_%	EW_mm	EWt_g	HU	YD_mm	YH_mm	YI_%
AH_mm	1.000	0.966**	-0.460	0.084	-0.143	-0.429	-0.849**	0.966**	0.176	0.210	0.008
AI_%		1.000	-0.586	0.167	-0.233	-0.500	-0.850**	0.933**	0.200	0.333	0.083
AW_mm			1.000	-0.100	-0.025	-0.117	0.510	-0.469	0.368	-0.435	-0.628
EL_mm				1.000	-0.950**	-0.417	0.250	-0.067	0.333	0.417	-0.100
ESI_%					1.000	0.633	-0.167	0.000**	-0.517	-0.400	0.233
EW_mm						1.000	0.400	-0.400	-0.783**	-0.050	0.583
EWt_g							1.000	-0.917**	-0.033	0.083	-0.050
HU								1.000	0.167	0.167	-0.017
YD_mm									1.000	0.250	-0.850**
YH_mm										1.000	0.217
YI_%											1.000

** correlation is significant at the 0.01 level. *correlation is significant at the 0.05 level. AH = albumen height, AI = albumen index, AW = albumen width, EL = egg length, ESI = egg shape index, EWt = egg weight, EW = egg width, HU = Haugh unit, YD = yolk diameter, YH = yolk height, YI = yolk index (Field work, 2022).

Table 3: Association between the Egg Parameters in Ijebu-Ode Market

	AH_mm	AI_%	AW_mm	EL_mm	ESI_%	EW_mm	EWt_g	HU	YD_mm	YH_mm	YI_%
AH_mm	1.000	0.883**	-0.042	0.050	-0.017	0.433	0.850**	0.530	0.017	-0.427	-0.217
AI_%		1.000	-0.343	-0.017	0.083	0.267	0.600	0.667*	0.050	-0.418	-0.333
AW_mm			1.000	0.259	-0.360	0.226	0.067	-0.427	-0.385	-0.202	0.326
EL_mm				1.000	-0.900**	0.633	0.100	0.150	0.117	0.293	0.083
ESI_%					1.000	-0.417	-0.167	0.117	-0.400	-0.301	0.183
EW_mm						1.000	0.417	0.283	-0.217	-0.176	0.200
EWt_g							1.000	0.100	0.300	-0.042	-0.100
HU								1.000	-0.283	-0.410	-0.167
YD_mm									1.000	0.477	-0.617
YH_mm										1.000	0.335
YI_%											1.000

** correlation is significant at the 0.01 level. *correlation is significant at the 0.05 level. AH = albumen height, AI = albumen index, AW = albumen width, EL = egg length, ESI = egg shape index, EWt = egg weight, EW = egg width, HU = Haugh unit, YD = yolk diameter, YH = yolk height, YI = yolk index (Field work, 2022).

Table 4: Association between the Egg Parameters in Sagamu Market

	AH_mm	AI_%	AW_mm	EL_mm	ESI_%	EW_mm	EWt_g	HU	YD_mm	YH_mm	YI_%
AH_mm	1.000	0.904**	-0.723	0.460	-0.234	0.218	0.142	0.787*	-0.008	-0.117	0.008
AI_%		1.000	-0.895**	0.567	-0.483	0.250	0.033	0.833*	-0.067	-0.117	0.067
AW_mm			1.000	-0.686*	0.711*	-0.251	-0.159	-0.586	-0.033	0.092	0.033
EL_mm				1.000	-0.717*	0.750*	0.700*	0.200	0.400	-0.500	-0.400
ESI_%					1.000	-0.150	-0.467	-0.217	-0.433	0.417	0.433
EW_mm						1.000	0.483	-0.067	0.133	-0.367	-0.133
EWt_g							1.000	-0.233	0.700*	-0.517	-0.700*
HU								1.000	-0.283	0.050	0.283
YD_mm									1.000	-0.833**	-1.000**
YH_mm										1.000	0.833**
YI_%											1.000

** correlation is significant at the 0.01 level. *correlation is significant at the 0.05 level. AH = albumen height, AI = albumen index, AW = albumen width, EL = egg length, ESI = egg shape index, EWt = egg weight, EW = egg width, HU = Haugh unit, YD = yolk diameter, YH = yolk height, YI = yolk index (Field work, 2022).

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