

# Description of the physical characteristics of the eggs from creole hens and commercial eggs

Rodríguez-Ortega, Leodan T.<sup>1</sup>; Hernández-Guzmán, Filogonio J.<sup>2</sup>; Pro-Martínez, Arturo<sup>3</sup>; Zárate Contreras, Diego<sup>3</sup>; Leyva-Jiménez, Héctor<sup>4</sup>; Rodríguez-Ortega, Alejandro<sup>1\*</sup>

<sup>1</sup> Universidad Politécnica de Francisco I. Madero, Tepatepec, Hidalgo, México. C. P. 42660.

<sup>2</sup> Universidad Autónoma Chapingo, Departamento de Ingeniería Agroindustrial, Texcoco, Estado de México, México. C. P. 56230.

<sup>3</sup> Colegio de Postgraduados, Programa de Ganadería, Campus Montecillo, Texcoco, Estado de México, México. C. P. 56264.

<sup>4</sup> United Animal Health, 322 S Main Street, Sheridan, Indiana, United States. Z. C. 46069.

\* Correspondence: arodriguez@upfm.edu.mx

## ABSTRACT

**Objective:** to compare the external and internal physical characteristics and yolk color of eggs with white, brown or blue shells from creole hens, and the commercial eggs with white and brown shells from hens bred in layer-farms, which are sold in the region of Mezquital Valley (Hidalgo), Mexico.

**Design/Methodology/Approach:** eggs from creole hens were collected in traditional markets (called tianguis in Mexico) customarily placed in the Mezquital Valley (Hidalgo), Mexico. The colors of the shell were blue (n=100), white (n=100), brown (n=100), in addition, pieces of eggs with white shell (n=100) and brown shell (n=100) were purchased in retailer stores. In those stores no eggs with blue shells were found. Variables evaluated in the eggs were weight, area, volume, shape index, length and width, whites and yolk weight; also, color intensity of the yolk was evaluated with the DSM™ Yolk color fan.

**Results:** the blue egg in this study presented ( $p \leq 0.05$ ) the highest weight (61 vs. 53,  $\pm 0.66$  g), area (72 vs. 65,  $\pm 0.67$  cm<sup>2</sup>) and volume (56 vs. 48,  $\pm 0.60$  cm<sup>3</sup>) compared to the creole white egg. Creole brown egg, as well as commercial white and commercial brown eggs had a similar shape index (78, 79 and 77,  $\pm 0.65$  %). Egg length was also similar; no significant differences were found ( $p > 0.05$ ). However, the creole white egg had the smallest egg width compared to the other types of egg. The blue egg had the highest weight of whites, and the creole white egg the lowest, compared to the other types of egg (36 vs. 30,  $\pm 0.51$ g). Creole blue, commercial white and commercial brown eggs had similar yolk weight (19, 18 and 18,  $\pm 0.52$  g). The commercial white and commercial brown eggs had the highest color intensity in the yolk (10.3 and 11.3,  $\pm 0.15$  DSM™ Yolk color fan), whereas the creole white egg had the least colorful yolk ( $7.4 \pm 0.15$  DSM™ Yolk color fan).

**Limitations/Implications of the study:** backyard poultry farming in the state of Hidalgo is limited by the loss of rural areas and creole hens are displaced by commercial breeds.

**Findings/Conclusions:** the blue egg from backyard creole hens was larger than the commercial egg, while the creole white egg was the smallest. However, this characteristic does not affect nutritional quality. Commercial white egg and commercial brown egg had the highest color intensity in the yolk. The color of the yolk is due to the carotenoids present in the yolk that are beneficial for human health.

**Keywords:** creole hens, commercial eggs, blue shell, physical characteristics, yolk color.

**Citation:** Rodríguez-Ortega, L. T., Hernández-Guzmán, F. J., Pro-Martínez, A., Zárate Contreras, D., Leyva-Jiménez, H., & Rodríguez-Ortega, A. (2026). Description of the physical characteristics of the eggs from creole hens and commercial eggs. *Agro Productividad*. <https://doi.org/10.32854/cyramb69>

**Academic Editor:** Jorge Cadena Iñiguez

**Associate Editor:** Lucero del Mar Ruiz Posadas

**Guest Editor:** Daniel Alejandro Cadena Zamudio

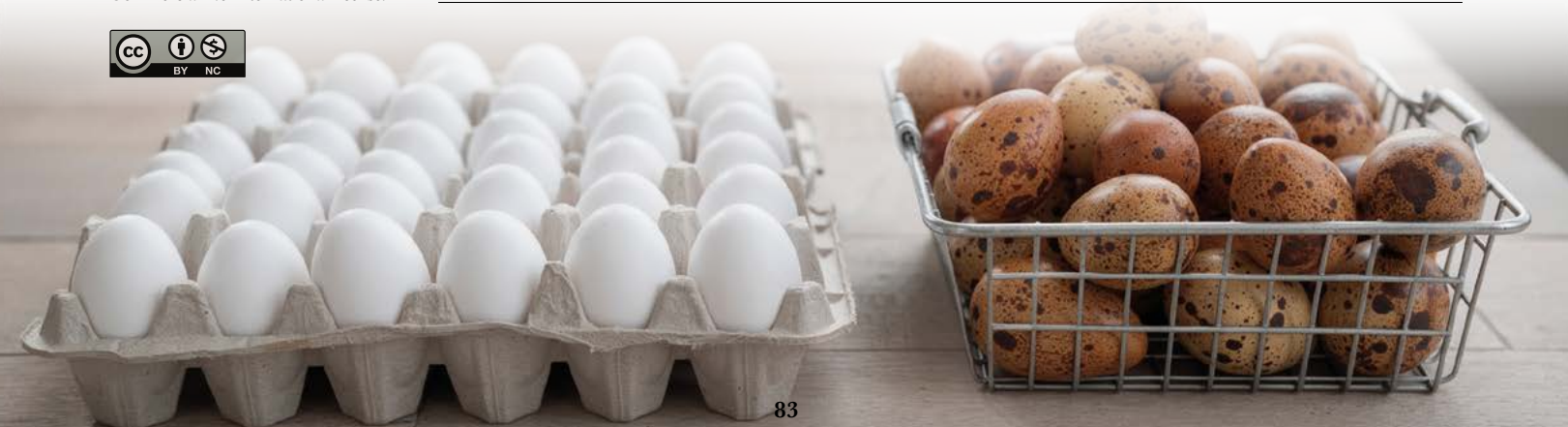
**Received:** February 25, 2025.

**Accepted:** April 16, 2026.

**Published on-line:** June XX, 2026.

*Agro Productividad*, 19(5). May. 2026. pp: 83-91.

This work is licensed under a Creative Commons Attribution-Non-Commercial 4.0 International license.



## INTRODUCTION

Eggs are an inexpensive and accessible source of protein for low-income families in Mexico. Creole hens are an important genetic resource that must be conserved and reproduced, since they have hardiness to survive in difficult places, also resistance to parasites and diseases (Toalombo *et al.*, 2019). Eggs from creole hens can be found for sale in traditional markets or retailer stores in towns or neighborhoods (Jerez-Salas *et al.*, 2009). Those eggs are an important source of income for low-income families in Mexico. Shades of color of shell are very varied; shells can be white, brown, blue or green (Rodríguez-Ortega *et al.*, 2020). Although stores and shops only sell commercial white and commercial brown eggs from specialized hens, also known layer-farm hens.

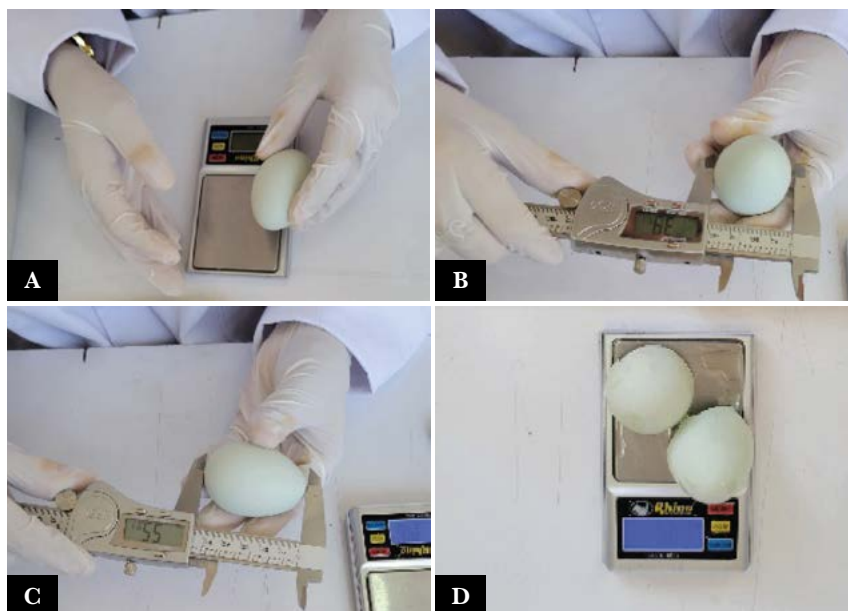
Creole hens range freely in the backyards of rural households, fed on insects, wild plants, seeds, and sometimes small amounts of concentrate. This domestic production system provides a state of well-being in the hens. However, in this type of farming, there is little management of parasites and diseases, which results in low production and high mortality. It seems necessary to promote backyard poultry farming; but the increase in urban areas has generated a reduction in small production units. This has caused the populations of creole hens, turkeys, ducks and geese to be severely reduced. The objective of this research was to compare the external and internal physical characteristics and yolk color of the eggs from creole hens with white, brown, or blue shells, and the commercial eggs of specialized hens with white and brown shells which are sold in the region of the Mezquital Valley (Hidalgo), Mexico.

## MATERIALS AND METHODS

The study was done at the UPFIM-Poultry Unit under the Polytechnic University “Francisco I. Madero” (UPFIM), which is located in Tepatepec (Hidalgo), Mexico. Egg pieces from creole hens were collected in the tianguis (the traditional Mexican street-market) of Actopan (Hidalgo) and in the tianguis of Tepatepec, in the municipality of Francisco I. Madero (Hidalgo), Mexico. Eggs were collected from creole hens with white (n=100), brown (n=100) and blue (n=100) shells, and eggs with white (n=100) and brown (n=100) shells were purchased in local retailer stores, no eggs with blue shells were found in those stores.

### External physical characteristics

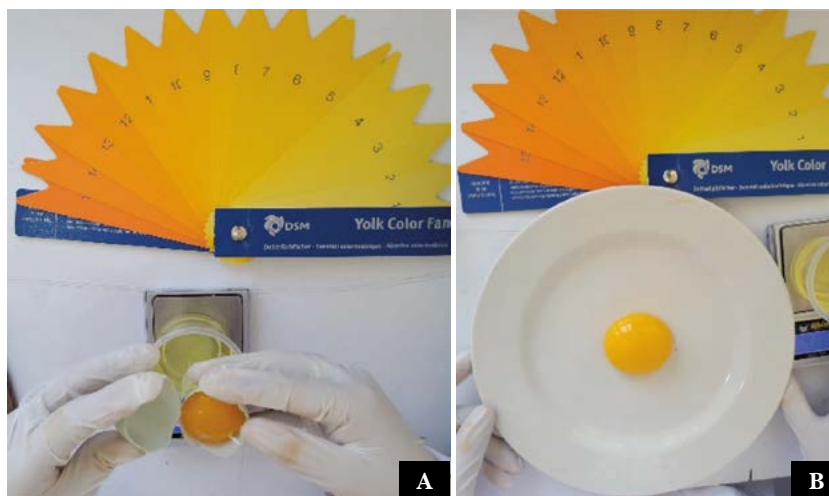
In a refrigerator, the collected egg was stored at 10 °C until analysis, the external physical characteristics were egg weight (P), length (L) and width (A), these were measured with a digital vernier (Model HER-411, STEREN, Mexico, Figure 1) with a measurement range of 0 to 150 mm and resolution of 0.1 mm. The shape index (Si) was obtained according to Rodríguez-Ortega *et al.* (2021), with the formula  $Si = A/L \times 100$ , the volume (V; cm<sup>3</sup>) was calculated as described by Illescas-Cobos *et al.* (2022),  $V = 0.913 \times P$ ; and area (A; cm<sup>2</sup>) according to Rodríguez-Ortega *et al.* (2021), with  $A = 4.558 \times P$ .



**Figure 1.** Measurement of egg pieces; A: egg weight, B: width, C: length, and D: shell weight.

### Internal physical characteristics

The internal physical characteristics evaluated were yolk weight, whites weight, and yolk color. The weight of the egg whites and yolk weight were recorded with a digital scale with a capacity of 200 g and a resolution of 0.01 g (Model MH-200, MKS Tools brand, China). Yolk color was determined visually, by comparing the color of the yolk with a value in the DSM™ Yolk color fan (Figure 2). Two evaluators agreed on the color that matched the one in the color fan. Colors of the fan range from 1 (the lightest) to 15 (the most orange). The color fan provides a convenient and economical way to assess yolk coloration.



**Figure 2.** Evaluation of yolk color with the DSM™ Yolk color fan.

### Statistical analysis

Egg weight, length, width, shape index, area, volume, whites weight, yolk weight, relative weight of whites to yolk, and yolk color were analyzed with the PROC GLM procedure. The means were compared with the Tukey test in SAS<sup>®</sup> (SAS Institute, Inc., 2013). The color of the yolk was analyzed with the GLM and PROC FREQ procedure of SAS<sup>®</sup> (SAS Institute, Inc., 2013). The PROC CORR procedure was used to determine the relation of egg weight to the weight of whites and shell weight.

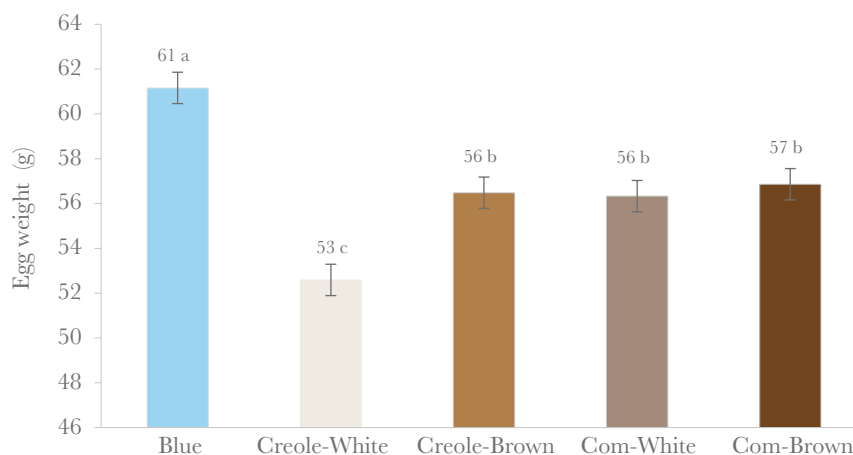
## RESULTS AND DISCUSSION

### Egg weight

The size and color of eggs are physical characteristics that attract the consumer. The blue color of the shell is due to biliverdin, a natural pigment that is deposited in the shell gland (Hernández-Guzmán *et al.*, 2021). The blue egg had the highest weight ( $p \leq 0.05$ ) compared to the other types of egg, whereas the white egg from creole hens [Creole-white] was the smallest ( $p \leq 0.05$ ) compared to the others (Figure 3).

Consumers prefer large and heavy pieces of egg, however, the size of the egg depends on the breed, age and diet of the hens (Hernández-Guzmán *et al.* 2021). Juárez-Caratachea *et al.* (2010) reported that the egg from creole hens is smaller than the egg from commercial breeds. However, internal quality is similar to that of the commercial egg. Such results coincide with those found in this study, commercial white and commercial brown eggs were larger than the white egg [Creole-white] from creole hens (Figure 3).

Oñate-Mancero *et al.* (2020) reported that eggs of creole hens are less heavy, weight does not exceed  $50 \text{ g} \pm 4.97$ ; in our study those results coincided only with the weight of the creole white egg. The Official Mexican Standard (NOM-FF-127-SCFI-2016) classified chicken eggs as follows; over 64 g they are considered extra-large; large 60-64 g; medium 55-60 g; small 50-55 g; and marble, less than 50 g. According to this classification in the Mexico's Official Gazette of the Federation (DFO, 2004), the creole white egg was labelled as small, and all the other types of eggs were large (Figure 3).



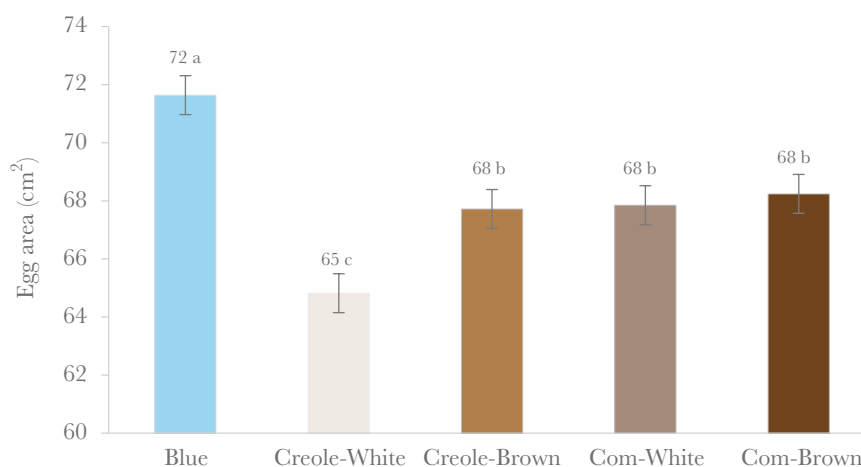
**Figure 3.** Weight of eggs; blue (Azul), creole white (Creole-White), creole brown (Creole-Brown), commercial white (Com-White) and commercial brown (Com-Brown). Different letters indicate significant differences (Tukey;  $p \leq 0.05$ ).

### Egg Area

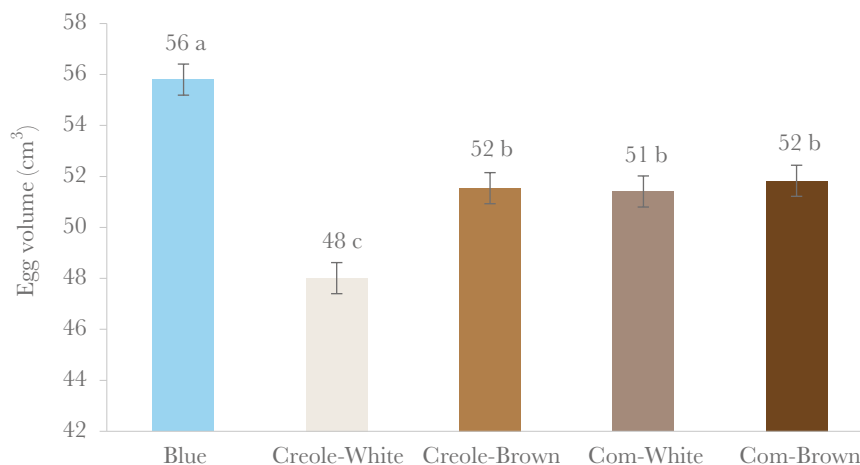
Egg area and volume are two important geometric variables for the poultry industry. Because large egg pieces make packing difficult (Narushin, 2005) and the calculation of those variables is not easy due to the sui generis shape of the egg. The eggs are not circular or elliptical, they are ovoid; the rounded wider end is called the base, and the pointed end is called the tip. They can be classified into four groups by form, oval, pyriform, circular and elliptical (Nishiyama, 2012). Eggs with blue shells had the largest area ( $p \leq 0.05$ ), while the white egg from creole hens had the lowest area value. The pieces of creole brown, commercial white and commercial brown eggs had a similar ( $p > 0.05$ ) area (Figure 4). These results are in agreement with those reported by Hloko *et al.* (2022), who evaluated the egg area of intensively bred hens and recorded values between  $64.96 \text{ cm}^2$  and  $71.16 \text{ cm}^2 \pm 0.26$ .

### Egg volume

Eggs from any bird begin to lose weight as soon as they are laid, but their volume and area do not change during storage or incubation (Karabulut, 2021). Volume is a variable that is related to egg weight and shell strength; estimation of area and volume can help to reduce losses due to transportation, storage and packaging. Larger eggs should be packed in materials that withstand the external forces exerted during grading and transport (Altuntas and Sekeroglu, 2008). The blue egg had the highest volume, while the lowest was observed in the creole white egg (Figure 5). The pieces of creole brown, commercial white and commercial brown eggs had ( $p \leq 0.05$ ) similar volume (Figure 5). Results in this study indicate that egg area and egg volume increased as the egg weight increased. This is in agreement with Rodríguez-Ortega *et al.* (2021), who observed that the volume of white eggs from Bovans White commercial hens was in the range from 59 to  $62 \text{ cm}^3$ .



**Figure 4.** Egg area; blue, creole white (Creole-White), creole brown (Creole-Brown), commercial white (Com-White) and commercial brown (Com-Brown). Different letters indicate significant differences (Tukey;  $p \leq 0.05$ ).



**Figure 5.** Eggs volume; blue, creole white (Creole-White), creole brown (Creole-Brown), commercial white (Com-White) and commercial brown (Com-Brown). Different letters indicate significant differences (Tukey;  $p \leq 0.05$ ).

### Egg length and egg width

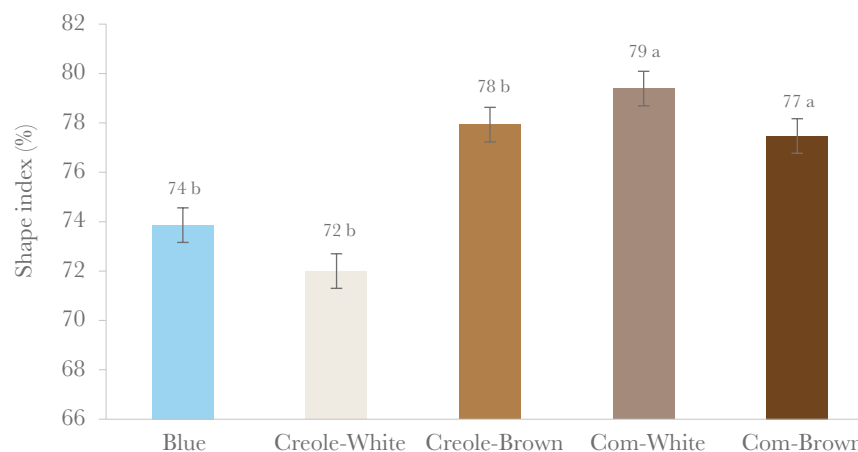
Length and width of eggs are important physical characteristics in the poultry industry. An increase in egg length can generate friction with the packaging material thus causing shell breaks. Egg length was similar ( $p > 0.05$ ) in the egg types evaluated (blue, 5.8 cm; creole white, 5.6 cm; creole brown, 5.7 cm; commercial white, 5.9 cm; and commercial brown, 5.9 cm,  $\pm 0.29$ ). However, there were significant differences ( $p \leq 0.05$ ) in egg width. The creole white egg presented the smallest ( $p \leq 0.05$ ) width value (4.1 cm  $\pm$  0.02), whereas width average value of eggs, blue, creole brown, commercial brown and commercial white, were similar (4.3 cm  $\pm$  0.02) for all the other types ( $p > 0.05$ ). The values in this study are similar to those observed by Hernández-Guzmán *et al.* (2021), who reported that the length of the blue egg from Araucana hens was 5.73 cm  $\pm$  0.26, and the width 4.33 cm  $\pm$  0.16.

### Shape Index

The shape index (Si) is the relation of egg width to egg length. Creole brown, commercial white and commercial brown eggs presented a similar ( $p \leq 0.05$ ) shape index; whereas, creole white and blue eggs had the lowest ( $p \leq 0.05$ ) value of shape index (Figure 6). Shape index is a variable with which the thickness of the shell can be predicted. Romera *et al.* (2022) observed that the shape index is correlated with shell strength, the higher the shape index value the lower the shell strength. Our results could indicate that commercial egg pieces are less durable than blue and creole white eggs (Figure 6).

### Whites weight and yolk weight of the eggs

The egg inside is composed of whites and yolk, and on the outside by the shell, whose main function is to protect the inside content (Rodríguez-Ortega *et al.*, 2020). Blue eggs had the highest ( $p \leq 0.05$ ) whites weight, while the creole white egg had the lowest (Table 1). The weight of whites in this study coincides with that reported by Rodríguez-Ortega *et al.* (2025), who reported the weight of whites in a range from 30 to 35 g.



**Figure 6.** Shape index of eggs; blue, creole white (Creole-White), creole brown (Creole-Brown), commercial white (Com-White), and commercial brown (Com-Brown). Different letters indicate significant differences (Tukey;  $p \leq 0.05$ ).

The highest yolk weight was found in blue eggs, commercial white and commercial brown eggs; whereas, the lowest yolk weight was observed in creole brown and creole white eggs (Table 1). The yolk weight in this study was similar to that observed by Rodríguez-Ortega *et al.* (2021), who found an average  $17.59 \text{ g} \pm 0.07$  value of yolk weight in the eggs from commercial Bovans White hens. Finally, shell weight was similar in all the types of egg evaluated (Table 1).

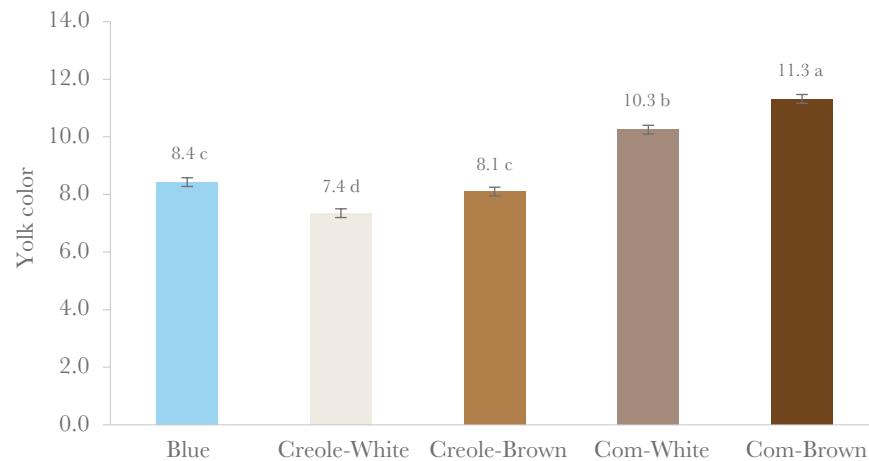
### Yolk color

Consumers prefer yolks with intense color, because people attribute to those a higher concentration of nutrients and greater freshness. The color of the yolk depends on the hen's diet. The yellow color of eggs yolk is due to the carotenoids present in the diet (Aparicio *et al.*, 2018). Lutein and zeaxanthin are the carotenoids with the highest presence in the yolk, these pigments are beneficial for human health, due to their antioxidant and anti-inflammatory effects (Rodríguez-Rodríguez *et al.*, 2021). Commercial white and commercial brown eggs had the most colorful yolks ( $p \leq 0.05$ ) compared to the other types of eggs (Figure 7). This result could be due to the consumption of commercial feed enriched with pigment.

**Table 1.** Weights of the whites, yolk and shells of eggs; blue, creole white, creole brown, commercial white and commercial brown, in Hidalgo, Mexico.

	White (g)	Yolk (g)	Egg shell (g)
Blue	36 a	19 a	8.0 a
Creole white	30 c	15 b	7.6 a
Creole brown	32 b	15 b	7.6 a
Commercial white	32 b	18 a	8.0 a
Commercial brown	33 b	18 a	7.8 a
Standard error	0.511	0.525	0.212
p-value	0.001	0.001	0.0584

Different letters within a column indicate significant differences (Tukey;  $p \leq 0.05$ ).



**Figure 7.** Yolk color in eggs; blue, creole white (Creole-White), creole brown (Creole-Brown), commercial white (Com-White) and commercial brown (Com-Brown). Different letters indicate significant differences (Tukey;  $p \leq 0.05$ ).

The commercial feed used for hens in layer-farms contains added pigments with the goal of increasing yolk color. The creole white, creole brown and blue eggs presented less intense ( $p \leq 0.05$ ) yolk color compared to the commercial eggs. This is probably due to backyard creole hens are fed on a diet with a minimum of commercial feed, but higher in kitchen residues such as bread, tortilla and some vegetables. Creole hens spend much of the day ranging in the wild, looking for insects or seeds to satisfy their physiological needs, thus consuming low concentrations of carotenoids.

## CONCLUSIONS

The egg with blue shell from hens in backyard poultry was larger than the commercial eggs, whereas the creole white egg was the smallest. However, this characteristic did not affect nutritional quality. The commercial white and commercial brown eggs had the highest color intensity in the yolk. That color is due to the carotenoids present in the yolk that are beneficial for human health.

Creole hens are a source of income from the sale of eggs and meat for low-income families in the Mezquital Valley (Hidalgo), Mexico. For this reason, it is considered necessary to promote the development of more backyard poultry farming, thus preventing creole hens from being completely displaced by commercial breeds.

## REFERENCES

- Altuntas, E., & Sekeroglu, A. (2008). Mechanical behavior and physical properties of chicken egg as affected by different egg weights. *Journal of Food Process Engineering* 33:115-127. <https://doi.org/10.1111/j.1745-4530.2008.00263.x>
- Aparicio, A., Salas, González, M.D, Cuadrado-Soto, E, Ortega, R.M., & López-Sobaler, A.M. (2018). El huevo como fuente de antioxidantes y componentes protectores frente a procesos crónicos. *Nutrición Hospitalaria* 35(N. Extra. 6): 36-40. doi: <http://dx.doi.org/10.20960/nh.2285>
- DOF (Diario Oficial de la Federación) (2017). NOM-FF-127-SCFI-2016 Productos avícolas-Huevo fresco de gallinas-Especificaciones y métodos de prueba (cancela a la NMX -FT-079-2004). Secretaría de economía. 22 pp. Retrieved: February 2025: [https://sitios1.dif.gob.mx/alimentacion/docs/NMX-FF-127-SCFI-2016\\_Huevo\\_fresco.pdf](https://sitios1.dif.gob.mx/alimentacion/docs/NMX-FF-127-SCFI-2016_Huevo_fresco.pdf)

- Hlokoe, V.R., Tyasi, T.L., Mbazima V., & Gunya, B. (2022). Investigation of Egg Weight, Ovarian Follicles Morphology and Growth Differentiation Factor 9 mRNA Expression in Potchefstroom Koekoek Chicken Breed. *Brazilian Journal of Poultry Science* 25(3): 001-008. <http://dx.doi.org/10.1590/1806-9061-2022-1723>
- Hernández-Guzmán, F.J., Rodríguez-Ortega A., González-Cerón, F., Mendoza-Pedroza, S.I., Rodríguez-Ortega, L.T., Crosby-Galván M.M. (2021) Descripción de los ácidos grasos del huevo de gallinas Araucanas y Marans. *Ecosistemas y Recursos Agropecuarios*. Núm. Esp. II: e2948: 1-7.
- Illescas-Cobos, A.A., González-Cerón, F., & Pro-Martínez, A. (2022). Caracterización morfológica y potencial reproductivo de los huevos de gallinas Criollas Mexicanas (*Gallus gallus domesticus*) dispuestos a incubación artificial. *TIP Revista Especializada en Ciencias Químico-Biológicas* 25: 1-9.
- Jerez-Salas, M.P., González-Martínez, A., Herrera-Haro, J.G., Vásquez-Dávila, M.A., Segura C.J. & Villegas-Aparicio, Y. (2009). Mercadeo de huevos de gallinas criollas (*Gallus gallus* L.) en los Valles Centrales de Oaxaca, México, *Etnobiología* 86-93.
- Juárez-Caratachea, A., Gutiérrez-Vázquez E., Segura-Correa, J. & Santos-Ricalde R. (2010) Calidad del huevo de gallinas criollas criadas en traspatio en Michoacan, Mexico. *Tropical and Subtropical Agroecosystems*, 12(2010): 109 - 115
- Karabulut O. (2021). Relationship between weight, volume and specific gravity of goose eggs before incubation. *Journal of Advances in VetBio Science and Techniques* 6(2):90-99.
- Narushin, V.G. (2005). Egg Geometry Calculation Using the Measurements of Length and Breadth. *Poultry Science* 84:482-484.
- Nishiyama, Y. (2012). The mathematics of egg shape. *International Journal of Pure and Applied Mathematics* 78(5): 679-689.
- Oñate-Mancero, F.J., Villafuerte-Gavilanes, A. A., & Bravo-Calle, O. E. (2020). Calidad de huevos de gallinas criollas criadas en traspatio en Macas, Ecuador. *Dominio de las Ciencias* 6(3): 662-673.
- Rodríguez-Rodríguez, E., Aparicio, A., Bermejo, L.M., Ortega, R.M., & López-Sobaler A.M. (2021). Implicación de los componentes antioxidantes del huevo en la protección macular y la mejora de la visión. *Nutrición Hospitalaria* 3(No. Extra. 2):9-12. DOI: <http://dx.doi.org/10.20960/nh.03789>
- Rodríguez-Ortega, L.T., Rodríguez-Ortega, A., Hernández-Guzmán, F.J., Callejas-Hernández, J., Pro-Martínez, A., & Leyva-Jiménez, H. (2020). Productive performance and egg physical characteristics of Tufted Creole and Marans hens. *Agroproductividad* 13(10): 69-73. <https://doi.org/10.32854/agrop.v13i10.1741>
- Rodríguez-Ortega L.T., Segura-Soto, C.E., Pro-Martínez, A., Sosa-Montes, E., Alejos-de la Fuente, I.J., & González Cerón, F. (2021). Macroestructura del huevo de gallinas alimentadas con diferentes niveles de proteína cruda. *Ecosistemas y Recursos Agropecuarios* Núm. Esp. II: e2917: 1-7.
- Rodríguez-Ortega L.T., Segovia-Azpeitia, S., Hernández-Guzmán, F.J., Rodríguez-Ortega, A., Pro-Martínez A., & Estrada-Hernández, M. de la L. (2025). Effect of annatto and alfalfa on egg yolk pigmentation in Creole hens. *Agroproductividad*, 17(10): 45-52.
- Romera, B.M., Advínculo, S.A., Canet, Z.E., Dottavio, A.M., & Di Masso, R.J. (2022). Dinámica del largo, el ancho y la forma del huevo en tres poblaciones de gallinas camperas. *InVet* 2022, 24 (2): 1-9.
- SAS Institute, Inc. (2013). SAS Language guide for personal computers, release 9.4 Edition. SAS Institute, Inc. Cary N.C. USA.
- Toalombo, P.A., Navas-González, F., J., Andrade-Yucailla, V., C., Trujillo, J., V., Martínez, J., & Delgado, J., V. (2019). Caracterización productiva y organoléptica de huevos de gallinas de campo de la Región Sierra del Ecuador. *Archivos de Zootecnia* 68(263): 412-415.