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EGG QUALITY BY COLORATION IN CREOLE HENS IN THE MUNICIPAL MARKETS OF THE PASTAZA CANTON, ECUADOR.

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Graphical Abstract

Table 1: Color relations by markets

Markets	White	Light Brown	Green	Total
Mariscal	10	48	25	83
La Merced	20	60	84	164
N	30	108	109	247

Table 2: Relationship of external quality by coloration of Creole eggs.

Indicators		Egg Color		
	N	White	Light Brown	Green
Egg weight, g		58,7±4,3	61,0±5,7	57,2 ±7,5
Egg height, cm		5,6±0,43	5,6±0,30	5,5 ±0,32
Egg width , cm	150	4,03±0,18	4,03±0,12	3,9 ±0,19
Eggshell thickness, mm		0,08 ±0,02	0,23±0,12	0,05±0,03

Abstract.

<< The purpose of this research was to carry out a retrospective analysis of the external and internal egg quality and its relationship with coloration, in the municipal markets of the Pastaza canton. The results of 247 creole eggs were analyzed, to which the indicators were measured: weight, height and width of the egg, shell thickness, shape index, yolk index, albumen index and Haugh units. An exploratory transectional or cross-sectional design was used and the data were processed in the statistical package SPSS version 22. The results indicate that there is a variation of the yolk diameter between the egg colors; the light brown and green coloration showed the highest values with 4.4 ± 0.30 and 4.3 ± 0.27cm respectively. The yolk index was higher in the light brown and green colored eggs, however, only the green color corresponds to the highest quality standards. The analysis of the Haugh units

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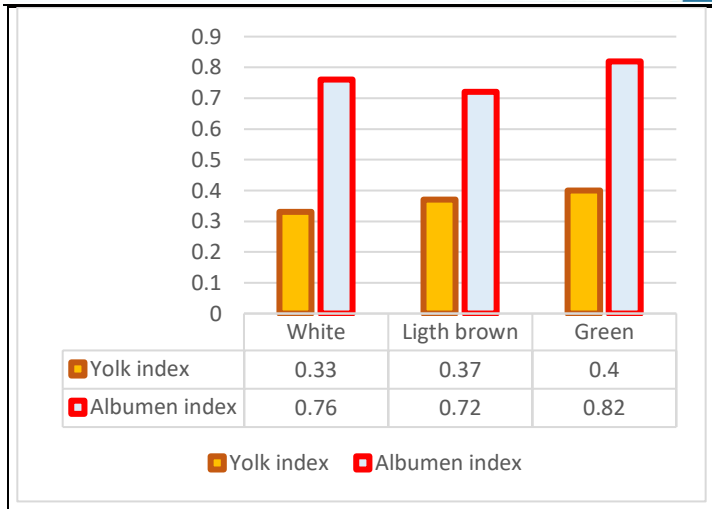

Figure 1: Yolk and albumen indices by color in Creole eggs

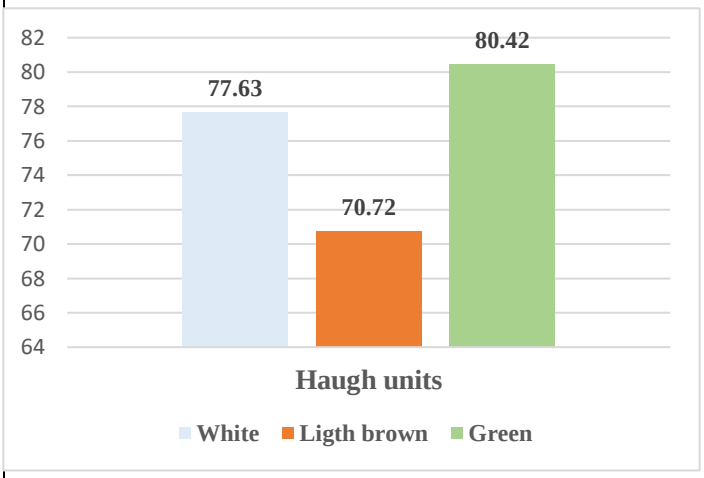

Figure 2: Behavior of the Haugh Units regarding the color of the eggs

showed 80.4%, which expresses very good quality for the marketing process and durability of the product; while the white and light brown eggs showed values between 77.63 and 70.72% respectively. The indicators height and diameter of the yolk and height and diameter of the albumen were higher for the green color, favoring the indices of yolk and white or albumen, which is why it is manifested in the Haugh Units by presenting very good quality.

A logical relation of the internal and external quality is not expressed for the green color, unlike the other colorations.

Keywords: Egg quality, coloration, markets, creoles

Introduction

In the last three decades, world egg production has increased by more than 150 percent. The 2019 statistics in Ecuador indicate that the weekly production of eggs comes in 91.44% from poultry farms and 8.56% from the field, of which 79.55% are destined for self-consumption, 14, 76% for sale and the remaining 5.69% for other purposes. The Sierra region is the one with the highest egg production with 77.81%, followed by the Coast with 15.39% and the Amazon with 6.80% (ESPAC, 2020).

Egg quality is an important factor in consumer acceptance or rejection, and is related to different internal and external characteristics. The shape, color and weight are factors that affect the classification, price and consumer preferences, while the quality of the shell is considered one of the most important elements due to its economic impact. The coloring of the shell is genetic, since each breed has different pigments which are deposited in the shell while it travels the oviduct of the hen, obtaining blue, white or green and brown eggs (Jaramillo, Mojica, Caro and Sosa, 2018).

The egg immediately after laying and during storage undergoes various biochemical, physical and mechanical changes. Several authors agree that in the course of time and at room temperature above 24ºC, the initial quality decreases until disappearing after 3 to 4 weeks (Estrada, Galeano, Herrera & Restrepo, 2010). In the different municipal markets of the Pastaza canton, the eggs remain at an ambient temperature of 20 to 25 ° C, with variations of 32 ° C. They do not have adequate storage and their nutritional and quality characteristics deteriorate over time; so the quality of the eggs may be affected.

Materials and Methods

Location

The work was developed from records belonging to the project "Conservation of autochthonous breeds", which were taken as exploratory data in the period of December 2019 and February 2020, in the Municipal Markets (La Merced, Mariscal and El Dorado) (Figure 7). Markets that are located in the Pastaza canton (Puyo), belonging to the Pastaza Province at an altitude of 930 meters above sea level, with an average temperature of 20 ° C (GAD Municipal de Pastaza, 2020), an average annual rainfall of 4990 mm and a relative humidity of 88% (INAMHI, 2016).

Shape index = width / length * 100.

White or albumen index = white height / white diameter.

Yolk or yolk index = yolk height / yolk diameter.

HU (haugh units) = 100 * log (h-1.7 W0.37 + 7.6).

Where:

h = Height of the white in (mm).

w = Egg Weight in (g).

A descriptive statistical analysis was performed on the data obtained, processed, by the statistical package SPSS version 22. (2016).

Results and Discussion

Table 1 indicates the color relationship by markets. Of the 247 eggs analyzed, 66,3% correspond to the La Merced market with the highest representation of white, light brown and green eggs, while 33,3% belong to the Mariscal market. The most representative colorations are light brown and green, with a total of 108 and 109 eggs respectively. The presence of green eggs is more marked in the La Merced market. Green eggs are produced when the biliverdin pigment predominates over protoporphyrin as expressed (Paredes, Romero, Torres, Vallejos & Mantilla, 2019). Some authors such as Pazo de Vilane (2020) and Delgado (2016) indicate the presence of an enzyme responsible for shades from blue to green and that is secreted in the distal part of the oviduct; Furthermore, it has been proven that this occurs in some breeds; as it is in Araucanian chickens.
It has been observed that in the Amazon the reference of the color of the eggs is the different shades of brown, however, the farmers of the field opt for eggs of greenish coloration (Toalombo, Villafuerte, Benavides and Oleas, 2016).

Table 2 analyzes the relationship of external egg quality by color in 150 eggs. The analysis showed significant weight variations between the different colorations (61, 0 to 57, 2g). The ligth brown colored eggs presented the highest values with 61.05 ± 5.7 g and, unlike the white and green colored eggs with 58, 7 ± 4, 27g and 57, 2 ± 7, 54 g, this does not mean that the weight is determined by coloration; since in the markets the storage time and environmental conditions can influence, when dehydration occurs or more porous eggs appear, so it can influence the weight. Like other authors Guerra (2016) affirms the effect of the age of the hens, their diet and the environment on the weight of the egg.

Regarding the width of the egg, the highest values were shown by the eggs with light brown and white color, both with 4,03cm. The quality parameter for the width of the egg is around 4,2 cm wide and for the height 5,7 cm (Periago, 2020). Juárez et al., (2011) mention that the width and height of the egg are

directly associated with the weight of the egg, that is, the heaviest eggs have larger diameters and vice versa.

The evaluation of the thickness of the shell is important for the commercialization process, so values from 0,28 to 0,37 mm are recommended as optimal thicknesses (Ramírez et al., 2016). However, all the eggs are below the optimal parameter for coloration, the thickness of the shell of the white and green eggs being very worrying with 0,08 ± 0,02 and 0,05 ± 0,03 mm. It has been proven that the decrease in the quality of the shell occurs as the age of the hen advances, it is believed that the hen is capable of synthesizing a uniform amount of material for the shell throughout its life, but gradually increasing the size of the egg there will be a lower absorption of calcium, which results in a thinner shell that is prone to ruptures, generating losses for marketers (Abarca, 2011). On the other hand, the decrease in the thickness of the shell is also attributed to the feeding system that in the case of Creole chickens have calcium and phosphorus limitations, causing eggs with weaker shells (Andrade et al., 2015).

In Figure 1 the behavior analysis of the yolk and albumen indices with respect to the color of the egg can be observed. These indices are important since they allow determining the freshness of the egg and are related to the height and diameter of the yolk and albumen, therefore, the quality standards suggest that the appropriate values for the yolk index is approximately 0,40 – 0,42 (Martín, 2019). As can be seen, the yolk index is higher in light brown and green eggs, however, only the green color corresponds to the highest quality standards. This behavior is also maintained for the albumen index. It is known that these indices are affected by storage and laying days, therefore, a reduction occurs as a result of the gradual weakening of the vitelline membranes due to the fact that the yolk absorbs the water of the albumin, losing its resistance properties, for which reduces its size compared to a freshly laid egg (Tasayco and Tarazona, 2019).

There are different factors that affect the quality of the albumen such as the genetic line, the time elapsed after the oviposition, the age of the hen, the storage conditions and the influence of time. Increases in temperature and prolonged storage time cause a rapid decrease in internal quality; It has been estimated that at temperatures above 15,5 ºC, alterations from dense to liquid albumin occur, this change possibly involves carbonic acid (H2CO3), which is dissociated into water and CO2, which increase the losses of humidity, carbon dioxide (CO2), and lead to the alkalization of the egg, altering its taste and reducing the viscosity of the albumin (Estrada et al., 2010).

The evaluation of Haugh units is of great importance since it is the most reliable measurement and the most accepted internationally, (Figure 2). The relationship of color with the Haugh Units (Figure 2) was

very interesting, because there was variability in quality; green eggs indicated 80,42%, which expresses a very good quality for the marketing process and durability of the product; while the white and light brown eggs showed values between 77,63 and 70,72%, which expresses a good quality. Many studies consider that the Haugh Units are related to factors that start from the handling of the hen in genetics, nutrition (protein in the diet and amino acid content) among others to the storage process (temperature and time) that can cause a thinning of egg white due to deterioration of ovomucin gel structure at high pH.

It is known that the process of collecting Creole eggs in the communities of the country lasts more than three days in the producers' homes and they are transferred to markets where there are no adequate storage conditions, which can affect quality. However, the eggs, depending on their coloration or biotype, showed very good to good quality, which may be related to the temperatures of around 25 ° C that generally remain in Puyo.

Conclusions

- The height and diameter indicators of the yolk and the height and diameter of the albumen were higher for the green color, favoring the yolk and white or albumen indices, which is why it is manifested in the Haugh Units by presenting very good quality.

- A logical relation of the internal and external quality is not expressed for the green color, unlike the other colorations.

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