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Zoogenic study of the native hen as a sustainable alternative for rural families of the Mexican tropic

Estudio zoogenético de la gallina autóctona como una alternativa sustentable para las familias rurales del trópico mexicano

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ABSTRACT

The objective of this research was to evaluate the zoogenic study of the autochthonous hen of the Mexican tropic. For this purpose, a survey was applied to communities that produce 12-month-old adult native hens (females and males). This research was carried out in three rural communities in the municipality of Nautla, Veracruz; Isla de Chapachapa, La Unión (El Poblado) and Cerro Dos Hermanos. Communities were selected because of their access to the land. The communities were selected by access to their dwellings to facilitate the collection of information from 80 hens. The following variables were taken into account: how the bird is known in the community, origin, distribution, breed characteristics, genetic description and productive characteristics. Descriptive statistics were applied to determine the dispersion of qualitative and quantitative data, using analysis of variance, followed by correlation and regression analysis. The most common plumage colors in the study communities were black, red and abada, which is what birds with a mottled plumage color (black with white) were commonly called. However, uncommon colorations were found, which were the result of mutations and natural crosses.

Keywords: Native hens, zoogenetic, sustainable, rural families, tropics.

RESUMEN

El objetivo de la investigación fue evaluar el estudio zoogenético de la gallina autóctona del trópico mexicano. Para ello, se aplicó una encuesta sobre las comunidades que producen gallinas autóctonas adultas de 12 meses de edad (hembras y machos). Esta investigación se desarrolló en tres comunidades rurales del municipio de Nautla, Veracruz; Isla de Chapachapa, la Unión (El poblado) y Cerro Dos Hermanos. Las comunidades fueron seleccionadas por el acceso a sus viviendas para facilitar la recolección de la información de 80 gallinas. Se tomaron en cuenta las siguientes variables: como se le conoce al ave en la comunidad, origen, distribución, características de la raza, descripción genética y sus características productivas. Se aplicó estadística descriptiva para determinar la dispersión de los datos cualitativos y cuantitativos, empleando un análisis de varianza, seguido de un análisis de correlación y regresión. Los colores de plumajes más comunes en las comunidades del estudio, fueron negro, rojo y abada, que es como comúnmente se les llamaban a las aves con un color de plumaje moteado (negro con blanco). No obstante, se encontraron coloraciones poco comunes, que eran resultado de mutaciones y cruzamientos naturales.

Palabras clave: Gallinas autóctonas, zoogenético, sustentable, familias rurales, trópico.



INTRODUCTION

In recent years, [FAO \(2013\)](#) seeks to reduce hunger and malnutrition through food and agriculture that contribute to improving living conditions, especially for the most vulnerable in an economically, socially and environmentally sustainable manner. To focus measures aimed at achieving its global goals of food security, poverty elimination and management. Using the natural resources of member countries to identify and implement policies, strategies and technologies that contribute to a sustainable and more adequate supply of products and services from agriculture, forestry and fisheries ([Foresight, 2011](#)).

The main focus of [FAO \(2013\)](#) is to achieve an ecosystem level of fisheries and aquaculture under Save to Grow. The program marked the intensification of sustainable crop production, the global agenda for sustainable livestock, sustainable forest management, the partnership for climate renewable agriculture and the initiative is to address water scarcity, adopted to varying degrees by countries. It is time to build on the rich body of knowledge and experience gained through these programs to develop a common vision and an integrated approach to sustainability in the areas of agriculture, forestry and fisheries ([Naciones Unidas, 2015](#)).

In addition to meeting humanity's basic needs for food, feed, fiber and fuel, the food sector employs one in three of the world's workers and provides livelihoods for rural households totaling 2.5 billion people ([FAO, 2013](#)). This sector contributes to social cohesion in rural areas and preserves traditions and cultural heritage ([Van Huylenbroeck et al., 2007](#)).

Some authors have developed studies, showing that projections, of the world population, which currently amounts to around 7.2 billion people, will reach 9.3 billion by 2050 ([United Nations, 2015](#)). This population growth and projected dietary changes linked to rising incomes and current consumption levels indicate that by 2050 at the latest, global agricultural production will have to increase by 60%, and by 100% in developing countries, to meet demand. In the past, technological innovation and institutional improvements led to considerable increases in production and productivity ([Wheeler & Von Braun, 2013](#)).

Family poultry farming is a worldwide activity and it is estimated that a large part of rural communities practice it, it contributes to a strategic element for food security due to its contribution of high biological value protein and economic contribution. In addition to having a wide genetic variety of domestic hens that help the adaptability of each specimen for greater production and high resistance to diseases ([Villacís Rivas et al., 2016](#)). In this sustainable system, birds are raised in backyards, with about 10 to 30 hens per household, fed with leftovers and small amounts of other food. Women and children are usually in charge of managing the family flocks ([Juárez, 2008](#)).



In rural communities, selection occurs naturally and it is the poultry farmers who make this selection based on the phenotypic characteristics of backyard poultry. Nowadays, much of this knowledge has been lost, including the management of these birds in the poultry pens. Reintroducing backyard poultry farming is of utmost importance both for the economy of rural families and for the implementation of healthy food of excellent nutritional quality (Lázaro *et al.*, 2012). Therefore, the objective of this research is to carry out a zoogenetic study of the native hen as a sustainable alternative for rural families in the Mexican tropics.

METHODOLOGY

For the elaboration of this work, a survey was applied to communities that produce 12-month-old adult native hens (females and males). These communities were selected because of access to their dwellings to facilitate the collection of samples. The data obtained were based on the type of feed, zootechnical purpose of the hens and selection of specimens. A format was implemented, in which phenotypic and production characteristics were recorded. 8 visits were made in the three communities selected for the study in Nautla municipality, Veracruz.

Zoometric Characterization. Each native hen sampled were adults (female and male) born in the same place or acquired in different communities. A total of 80 hens were observed in the three municipalities, taking into account the following variables: name as known in the community, origin, distribution, characteristics of the breed, genetic description and productive characteristics.

RESULTS AND DISCUSSION

The results found describe the phenotypic characteristics that encompass visible characters such as: skin, hair, plumage, color (Juárez, 2008; Alexi *et al.*, 2017).

According to Cadenas *et al.* (2015), firstly, skin color is determined by the -w- "yellow skin" gene. This also gives the yellow color to the beak and legs which is how the lower limbs of backyard birds are commonly known. A characteristic that is transferred by genes as an important inheritance. The coloration of the skin is denoted under the skin (Barzola, 2015).

Plumage color is affected by a great variety of genes, in addition there are modifier genes that are not well known, even some breeds, and it is very common to classify them by the color of their plumage (Macri *et al.*, 2019). The inheritance of these genes is not equal in the distribution of color in all parts of the body, which further complicates the identification of the genetic map of color, there are even genes whose effect is to determine the distribution of color in each feather.



1.- Gallus domesticus L. subspecies *inauris* n.l “aretona”

Local names: Santandereana, Ecuadorian, Chilean, De aretes, Araucana, Easter egg hen, Collonca de aretes. Center of origin: South America. Distribution: National.

Characteristics of the breed: It has abundant plumage around the face and ear, simulating earrings, lacks uropygial gland, due to the lack of coccygeal vertebrae. These birds come from blue-shelled eggs. Genetic description: The blue egg color is an autosomal dominant mutation, totally segregated to the white shell. Productive characteristics: Males reach a weight of 3 kilograms and females 2.5 kilograms. Eggs with blue shell have a maximum weight of 70 grams.

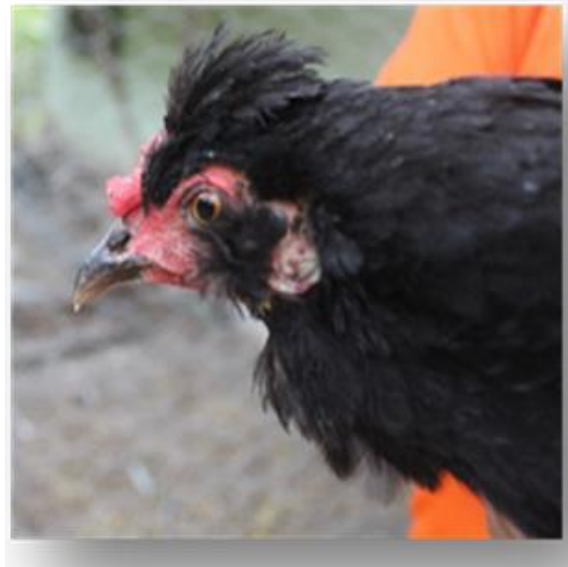


Figure 1. Specimen inauris

2.- Gallus domesticus L. subspecies *barbatus* n.l. “barbuda”

Local names: *Tufus*, *barbada*, *tufa*. Center of origin: Asia. Distribution: National.

Characteristics of the breed: It has abundant plumage on both sides of the auricular region and around the face, simulating a compact beard, with sideburns on the sides. There are variations in the color of the plumage and the eggs are usually brown. Genetic description: The plumage characteristics are due to an autosomal dominant gene, called *Mb*. Productive characteristics: Individuals weigh 2.5 kilograms for males and 2.0 kilograms for females. Eggs weigh a maximum of 55 grams and lay between 120-150 eggs per year.



Figure 2. Barbatus specimen



3.- *Gallus domesticus* L. subspecies *ecaudatus* n.l “bolita”

Local names: *Tapuncha, tapa, récula, francolina*. English names: Rumpless Fowl, Rumpkin, Persian Cock. Center of origin: Asia. Distribution: National. Characteristics of the breed: The lack of rump in birds, is a hereditary variation, which consists in the lack of 14 to 16 tail feathers, such birds seem more collected, short and spherical. The color of the plumage is very varied, the color of the eggs is brown. Genetic description: This dominant gene is called "Rp", which is hereditary and the lack of rump is of the intermediate type. Due to modifier genes these cause the vertebrae to fuse. Productive characteristics: Males of this breed can weigh up to 2.0 kilograms, and females can reach a weight of approximately 1.5 kilograms and eggs with a weight of 58 grams.



Figure 3. Ecaudatus specimen

4.- *Gallus domesticus* L. subspecies *nidícolas* n.l “guinicas”

Local names: *Carioca, cuello desnudo, cuelli pelada*. English names: Turkens-Naked Necks. Center of origin: Asia. Distribution: National. Characteristics of the breed: It is considered a mutation in the distribution of feathers. These specimens not only lack feathers on the lower part of the head, but they do not exist, except for the part closest to the crest, which means that it also lacks follicles. The dorsal part of the neck lacks feathers, except for the part at the anterior spinal tract. The naked skin of the neck can be observed, which becomes reddish at sexual maturity. The color of the plumage is varied, and the eggs are brown. Genetic description: The variation of the naked neck is due to a dominant gene, "Na", being an example of the differentiation of a breed by a single gene. Productive characteristics: The weight for males is 2.5 kilograms, in females reaching an approximate weight of 2.0 kilograms and the weight of the eggs is 70 grams.



Figure 4. Nidícolas specimens



5.- *Gallus domesticus L. subespecies crispus. n.l "rizada"*

Local names: *Chusca, Crespa, Chiroza, Churrumba, Chirapa, Rizada, Trintre.*

Center of origin: Asia. Distribution: National. Characteristics of the breed: The plumage of the hens has a "curly" appearance, hence the peculiar name of "curly hen", is a variation in the structure of the feathers, is characterized because the outer feathers, head, neck, trunk and wings are curved forward from the tip and twisted or rolled in one or more times, looking frizzy and fluffy. The plumage is usually variegated in color and in the case of eggs they are brown. Genetic description: The curly plumage is due to a partially dominant autosomal gene with a recessive autosomal modifier, "*mf*". This characteristic is difficult to maintain in the Creole breeds, due to the variety of genes that exist in a single pen, because of crossbreeding. The modifier gene, if it were in a controlled environment as in stabled systems, where only one type is abundant, would be considered the class that would be preserved and accumulated in natural selection. Productive characteristics: The weight of the male specimens is approximately 2.5 kilograms and the females weigh 2.0 kilograms. Egg color varies from white to brown, weighing 70 grams.



Figure 5. Crispus specimen

6- *Gallus domesticus L. subespecies pugnax n.l "gallina fina"*

Local names: *Gallina Fina* or *De peleá*. English: Old English game. Center of origin: Asia (India). Distribution: National. Characteristics of the breed: There is very little recorded information, specimens are observed with a varied plumage color and the eggs are usually white. General Description: These birds are very similar to their trunk of origin, coming from the *Gallus bankiva*. The male specimens were selected for "cockfighting", due to their complexion and temperament, the females, on the other hand, are considered excellent incubators and have the best maternal ability.



Figure 6. Pugnax specimen



7.- *Gallus domesticus L. subspecies gigantes n.l "calzada"*

Local names: *Zamarrona, calzada*. English: Cochins, Brahmas, langshan. Center of origin: Asia Distribution: National. Breed characteristics: The distribution of feathers is on the legs and toes. It becomes more abundant along the outer edge of the tarsus-metatarsus and on the outermost phalanx. The color of the plumage is varied and the eggs are brown. Genetic description: There are still no genetic studies to prove the cause of the mutation. "*Ptilopodia*" birds are classified by the characteristic of the plumage on legs, commonly called "*shod feet*", this breed is obtained by crossing ptilopodia birds and birds without feathers on the legs, called "F1 generation". In some cases, there are young animals that lack nails and some of the toe phalanges. Productive characteristics: Males have a maximum body weight of up to 3.0 kg and females weigh up to 2.5 kg and the eggs of female birds weigh up to 60 grams.



Figure 7. Giant specimen

8.- *Gallus domesticus L. subspecies cristatus n.l "copetona"*

Local Names: *Copetonas, Copetudas, Moñudas*. Center of Origin: Asia and Europe, with presence in South America. Distribution: National. Breed Characteristics: This variation is due to the length of the feathers and to the fact that some feathers of the head are extremely long, almost erect, which, instead of remaining attached to the head, are distributed forming a plume. The feathers fall over the eyes, covering the face. The color of the plumage can be varied, and the color of the eggs is brown. Genetic Description: The "*topknot*" is caused by an autosomal partially dominant gene, "*Cr*", is a dominant hereditary trait. It is closely linked to curly, white dominant and presence of hernia in homozygous specimens. Productive Characteristics: Males weigh 2.0 kilograms, females 1.5 kilograms and the weight of the eggs is 55 grams.



Figure 8.- Specimen cristatus



9.- *Gallus domesticus* L. subspecies morio n.l "colorada".

Local names: *Nicaragua, Mora, Ethiopian*. Presence in South America, but no pre-Columbian reports. English names: Black Fowl. Breed characteristics: Fibromelanosis is the melanic pigmentation of connective tissue, which is present in these birds. It is found in the dermis of the skin, muscles, nerves, tendons, blood vessel walls, *dura* and *pia* mater of the brain. Genetic description: Fibromelanosis is thought to be inhibited by a sex-linked gene, which researchers believe may be identical to the "*Id*" gene, which inhibits dermal melanin-linked melanin. When crosses occur, due to the action of the inhibitor, all F1 birds have black skin. Productive characteristics: Females have a maximum weight of 1.5 kilograms, males reach 2.0 kilograms approximately, since they vary in this proportion, and eggs weigh 45 grams.



Figure 9.- Morio specimen

10.- *Gallus domesticus* L. subspecies nanus

Local names: *Cubana normal, kika normal, kike normal*. Center of origin: Asia and Europe (Germany). With presence in South America, without pre-Columbian reports. Distribution: National. Characteristics of the breed: This breed has a small body size, very similar to the previous one, its most peculiar characteristic is the color of its eggs. The color in its plumage is varied and the eggs range from white to the so acclaimed "*blue or green*" color, although there are also cases of different shades. Genetic description: The reduction in size is usually associated with sex, these birds have fewer genes with cumulative effects for body size, compared to large and medium breeds. Dominant sex-linked genes linked to body size reduction have been found in crossbreeding between males of *Bamtams Sebright (Cuban)* breeds and *Brahma Ligera (normal size)* females. Productive characteristics: Males reach a maximum weight of 1.0 kilograms while females weigh around 750 grams and the weight of the eggs is 40 grams.



Figure 10.- Nanus specimen



11.- *Gallus domesticus* L. subspecies *dorkingensis* n. l "currita"

Common names: *Paticorta*, *Enana*, *Reptadora*. Center of origin: Asia, England, Germany. Distribution: National. Characteristics of the breed: This variation is generated in the appendicular skeleton, the body size is normal, but the long bones of the hind limbs are shortened. The most affected bone of all is the tibia, the fibula of the Creeper breed is thicker. The color of the plumage of these specimens is varied and they lay brown eggs. Genetic description: Thanks to the mutation, "Cp", which produces the anomaly in heterozygotes. In the case of homozygous specimens it is usually fatal. In the breeds called crawlers, this gene causes their legs and wings to be shortened, deforming their way of walking. When these birds mate, their offspring die on the fourth day approximately, since their hind limbs are almost glued to the body and only a few manage to survive. These dominant genes cause physical abnormalities in heterozygous specimens and embryonic death in homozygotes. Productive characteristics: With a maximum weight in males of 2.5 and females is 2.0 kilograms, the weight of their eggs is 60 grams.



Figure 11.- Specimen dorkingesis

The color of chicken plumage is determined by two types of pigments, which are: Eumelanins and pheomelanins. Eumelanins are responsible for black and blue-gray color, and pheomelanins are responsible for red, brown and fawn. But the most important multiallele gene for the color of hen plumage is "E", responsible for the extension of black color and presence of aperdizados in females, in addition to differences in the color of newly hatched chicks (Cadenas *et al.*, 2015). There are 7 alleles listed from most to least dominant: The E allele produces totally black birds in both sexes. The ER "Birch" allele produces black birds, but there are areas that are not completely black, especially in the neck and head, in both sexes, that is, without sexual dimorphism with respect to color. The e genes are 5 and cause a marked sexual dimorphism. All of them are recessive with respect to E and ER and there are different degrees of dominance among them (Jáuregui *et al.*, 2012).

Males with the "e" gene, present the "wild" type plumage, which is no more than the basic black color, but with reddish-yellowish coloration in the scape, saddle and wing tip (Revelo *et al.*, 2017). For females "e" is very different, they present the following plumage types: ewh "Wheaton", deep reddish-brown scape, brown back with discrete black or gray markings, some black feather on tail and belly and very light cream-colored breast, almost white. e+ "wild type", very dark gray back with fine flecks, scape with yellow feathers and



salmon breast eb "Brown", the whole body brownish, with abundant scabbing marks, scape with yellow feathers ebc "Buttercup", similar to the previous one, but more yellowish and more marked scabbing marks. eY is the most recessive of all and has similar color to Wheaten ([Jáuregui et al., 2012](#)).

Silver -S- The gene is sex-linked, when the dominant allele -S- appears, it inhibits the production of red pigment - pheomelanins-, this causes non-black feathers to turn to a white color, having no effect on black pigments - eumelanins- ([Cadenas et al., 2015](#)).

Blue -Bl- The gene is a diluent of the black pigment, when present in a homozygous dominant form it almost completely dilutes the black color, thus feathers that were black take on a dirty white or gray color. In heterozygosis -Bl bl- the black feathers become blue-gray ([Campos, 2014](#)). Dominant white -I-

It is a gene that causes with its appearance, the inhibition of the formation of black pigment, and also reduces the formation of red pigment, the chicks are yellow. It carries the W+ gene and a special allele (id) for dermal melanin pigmentation in legs([Campos, 2014](#)).

Recessive white -c- It is an autosomal recessive gene, whose homozygous -cc- gives rise to totally white animals, with yellow or grayish white chicks. The dominant -C- allows the expression of the basic color ([Cigarroa et al., 2013](#)). Apeartized gene -Pg-

This gene only manifests itself in females of genotype "eb", giving rise to a triple banding of feathers, presenting a brown layer with black, in males, it is with much more black ([Campos, 2014](#)). Bordered gene -Lg-

Produces a black border on the feather and the rest becomes white, except if the "s" gene is present, in which case the rest would be golden. According to ([Campos, 2014](#)), it is also known as "barred black", the color of the legs is

due to a dominant allele (W). Lentiger gene -Sp-. A black spot originates at the end of the feather, forming a "V". As in the previous case, the rest of the feather would be golden or white depending on whether the "s" gene is present or not, some yellowish brown wisps appear, looking like a triangle of the wing and the tail is white ([Tovar et al., 2014](#)). Mottled gene -mo-. Recessive gene whose presence determines that in the apex of the feather a black spot in the shape of a "V" is present, but in this case, the pigment is eliminated in the apex, thus producing a dark feather with a white tip ([Revelo et al., 2017](#)).

Over the years, modern poultry farming with its improved hen lines, took greater importance, due to its high productivity in a short time (8 weeks) of egg and/or meat, in such a way that the native hen cannot compete. But surprisingly, it is still more important in those communities where the selection of Creole hens continues to be implemented, due to their hardiness and resistance to diseases. While others are looking for ways to eliminate culling in chickens, rural communities seek to obtain birds that reproduce naturally, guaranteeing food security for their families ([Sonaiya et al., 1999](#)).

In addition to obtaining eggs, which are a high source of protein, they are also used for incubation to preserve the genes of the lineage. Since the domestication of native hens, different mutations have been observed, which characterize each breed in particular. The changes made in the germ plasm cause certain alterations that are reflected in the phenotype or appearance of the hens. Some specimens do not present such mutation,



because they carry a recessive gene, this means that the change in a single gene will not produce a visible effect until two birds carrying the same mutation are not paired (Valencia, 2009).

CONCLUSIONS

In the rural communities visited in the tropics, the zootechnical purpose of the native hens is for self-consumption and the surplus for the sale of meat and eggs. The most common plumage colors in the study communities were black, red and abado (plumage mottled with black and white). In addition, uncommon colorations were found as a result of mutations and natural crosses.

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