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# Morphological characteristics of the Philippines CARAGA black native chicken

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**Abstract**

The study was performed to describe the morphological characteristics of the Caraga black native chicken. A total of 40 heads of the native chickens (8 roosters and 32 hens) were used. The test animals are the product of the breeding and purification project of the Caraga black native chicken. The result of the morphological characteristics shows a predominant black coloration on the significant body parts of the native chicken, such as black plumage, black comb, black air lobe, black shank, black skin color, dark–brown Iris, dark grey beak, grayish meat, black bones, and black wattle shanks. Moreover, quantitative body measurements on 12-month-old native chicken recorded that the rooster is heavier (1.9Kg), taller (33cm), and has a higher body length (24cm) than the hen (weight = 1,350g, height = 28.5cm, body length = 24cm). Based on the findings, hens are generally smaller than roosters, which can be attributed to the body build of roosters. Males, naturally, are suited for muscle building, while the hens' body is built for reproduction.

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## Introduction

As an archipelagic country, the Philippines has more than 7,100 islands. Despite introducing exotic commercial breeds and hybrids of chickens, in the year 2000, more than 50% of the chicken population was still composed of native and upgraded types. Some of these native chickens are: 'Banaba,' 'Bolinao,' 'Camarines,' and 'Paraoakan' (Lambio, 2000). As early as 1998, the role of native chickens in the Philippine economy has been recognized. The Philippine native chickens' ability to produce meat and eggs under minimal management, intervention, and feeding inputs is why the Philippines' native chicken has been the primary source of meat and eggs for Filipino farmers (Dusaran, and Cabarles, 2005; Dusaran RN, and Pabulayan, 2012). Moreover, native chickens have higher muscle mass, less fat (Alano, 2015), and unique taste, flavor, texture, and nutraceutical compounds. That is why the price of the native chickens' meat and eggs are higher than commercial meat- and egg-type chickens (Lambio, 2000).

The Philippines is considered one of the biodiversity hotspots in the Indo-Australian Archipelago (Myers *et al*., 2000). Six (6) out of 243 recorded local poultry breeds in Asia could be found in the Philippines (Gaither and Rocha, 2013). However, limited studies were conducted on native chicken. To address this issue, the Department of Science and Technology-Philippine Council for Agriculture and Natural Resources Research and aquatic Development (PCAARRD) launched and funded projects purposely for research, preservation of the species, instruction, dispersal to farmers, and commercialization of the product and the Philippines native chicken (Godinez *et al*., 2021). Because of the help of DOST- PCAARRD, six Philippine native breeds were identified and studied. These are the Banaba chicken in Southern Tagalog, the Camarines chicken in Bicol, the Darag chicken in Panay Island, the Boholano chicken in Bohol, the Bolinao native chicken in Ilocos region, and the Zamboanga Peninsula (ZamPen) native chicken in Zamboanga. These native chicken strains underwent purification with the help of the DOST-PCAARRD (Sarian, 2019). Aside from the six identified and purified Philippine native chickens, another study on the new breed of native chicken endemic in the Caraga region was conducted in 2019. The Caraga black native chicken is locally known as Patani.

The Caraga Black Native Chicken known as Patani is endemic in the Caraga region. This native chicken possessed distinct morphological traits among the identified Philippine native chickens because of its black plumage, skin, and shank. Further, it has a unique taste, less body fat, and can quickly adapt to the changing environmental conditions of the Caraga Region. However, this genetic group is in small number, and this might be attributed to crossbreeding of other native genetic groups. Hence, conservation measures must be implemented through intensive breeding and selection and the phenotypic characterization of the Caraga black native chicken. It was common knowledge in the field of breeding and purification that for research and preservation of the Philippines native chicken to be successful, phenotypic characterization is necessary. Phenotypic characterization/ morphological characteristics is the method of identifying distinct breed populations and describing their characteristics and those of their production environments (Rogelio *et al.,* 2013).

This study studied the Caraga black native chicken's phenotypic characterization, morphological characteristics, and morphometric characteristics. The morphological features include the plumage pattern, skin color, shank color, comb type, and earlobe color. Moreover, a quantitative body measurement consists of the body length, shank length, wingspan, and chest circumference.

## Materials and methods

*Locale of the Study*

The study was conducted in the Organic Native Chicken Project area, Caraga State University-Main Campus. The facilities consist of one breeder house, seven grower cages, six brooder boxes, one incubator, and one hatcher. The house design was from Iloilo's Darag native chicken breeder house. It has eight cages, and every cage sized 245cm × 120cm × 350cm.

Each coop has three nests positioned at the same level or height. The grower cage measured 400cm x 400cm, and the brooder boxes were sized 127cm x 82cm x 52cm with 50 watts incandescent bulb. Flooring filled with rice hulls.

*Test Animals*

A total of 40 heads (8 roosters, 38 hens) of native chicken from the F1 generation of the breeding and purification project of the Caraga black native chicken were subjected to phenotypic and morphological characteristics.

*Morphological Classification and Data Analysis*

Morphological characteristics and morphometric measurements of the CARAGA black native chicken were based on the FAO Animal Production and Health Guidelines No. 11: Phenotypic Characterization of Animal Genetic Resources (FAO, 2011). Morphological characteristics include feathering characteristics covering only plumage patterns, while skin characteristics considered skin color, shank color, comb type, and earlobe color. The average quantitative body measurements, including weight, height, body length, shank length, wingspan, chest circumference, primary feathers, and secondary, were calculated using Microsoft Excel 2016.

## Results and discussion

*Morphological characteristics*

Qualitative traits such as plumage color, comb color, earlobe color, shank color, skin color, earlobe, and wattle color manifest the dominant black coloration in both hen and rooster. The hen and rooster have the same dark brown iris. Moreover, the hen and rooster display the same plain plumage pattern, upright body carriage, and single comb type, as reflected in Table 1.

**Table 1.** Morphological characteristics of hen and rooster of Caraga black native chicken.

| Morphological Characteristics | Rooster | Hen |
|---|---|---|
| Plumage | Black | Black |
| Plumage Pattern | Plain | Plain |
| Body Carriage | Upright | Upright |
| Comb Type | Single | Cushion |
| Comb Color | Black | Black |
| Earlobe Color | Black | Black |
| Shank Color | Black | Black |
| Skin Color | Black | Black |
| Iris Color | Dark Brown | Dark Brown |
| Beak Color | Black | Black |

Compared to the four genetic groups of the Philippine native chickens, the Caraga native chickens manifest the distinct feature attributed to the black coloration on most of its morphological characteristics (Table 2, Fig. 1).

**Table 2.** The morphological characteristics of the five genetic groups of Philippines native chickens.

| Parameters | Mean | Min. | Max. |
|---|---|---|---|
| Hen | | | |
| Body Weight (Kg) | 1.35 | 1.25 | 1.45 |
| Height (cm) | 23 | 22 | 24 |
| Body Length (cm) | 19.5 | 19 | 20 |
| Wingspan (cm) | 64 | 62 | 66 |
| Shank Length (cm) | 8.25 | 7.5 | 9 |
| Chest Circumference (cm) | 30 | 28 | 32 |
| Primary Feathers | 14 | 14 | 14 |
| Secondary Feathers (cm) | 17.5 | 16 | 19 |
| Roosters | | | |
| Body Weight (Kg) | 1.90 | 1.6 | 2.2 |
| Height (cm) | 28.5 | 27 | 30 |
| Body Length (cm) | 24 | 23 | 25 |
| Wingspan (cm) | 77 | 74 | 80 |
| Shank Length (cm) | 10.5 | 10 | 11 |
| Chest Circumference (cm) | 33.5 | 33 | 34 |
| Primary Feathers (cm) | 16.5 | 15 | 18 |
| Secondary Feathers (cm) | 20 | 17 | 23 |


**Fig. 1.** The rooster and hen of the Caraga Black Native Chicken.

The native chicken's black coloration on its dermis and tissues is the mutation called fibromatosis. Fibromelanosis is the abnormal accumulation of the dark pigment melanin in the avian body's dermis and connective tissue formations. Fibromelanosis (Fm) is due to an autosomal dominant gene(s) called endothelin three or EDN3. (Lukanov and Genchev, 2013; Bittel, 2019).

Endothelin 3 (EDN3), mostly found in vertebrates, is the one that controls the skin color. The endothelin 3 (EDN3) is the reason for migrating melanoblasts, or cells responsible for creating color.

In hyperpigmented chickens, all the chickens' body cells show or release EDN3, resulting in up to 10 times as many melanoblasts and black pigment on the chicken's dermis (Bittel, 2019).

*Quantitative Body Measurements*

The quantitative body measurements of a 12-month-old Caraga black native chicken show that a rooster is heavier, taller, and has a higher body length than a hen. Rooster with an average weight of 1.9Kg, a height of 33cm, body length of 24cm, wing span of 77cm, shank length of 10.5cm, chest circumference of 33.5cm, primary feathers of 16.5cm, and secondary feathers 20cm. The hen, on the other hand, has a body weight of 1.35Kg, height of 28.5cm, body length of 19.5cm, a wingspan of 64cm, shank length of 8.25cm, a chest circumference of 30cm, primary feathers of 14cm and Secondary feathers of 17.5 as shown in Table 3.

In most birds, males are more prominent. The ideal size of the male in most species of higher vertebrates, including birds, was that the males compete with one other for mates. In these struggles, those that are larger or stronger than the average will have an advantage. They will secure more mates and leave more offspring. Hence, Darwin claimed that the larger size of the males of most birds and mammals is the result of adaptation (Darwin, 1874). Among the five genetic groups of Philippine native chickens, Patani is the heaviest both rooster and hen (R = 1.9Kg, H = 1.35Kg) have the longest wing span (R = 77cm, H= 64cm), and the highest chest circumference (R = 33.5cm, H = 30cm). In terms of height, the Patani rooster is the tallest at 28.5 while both Zampen and Darag hens are the tallest at 24cm, and for the body length, the Darag rooster and hen obtained the highest body length (R = 43cm, H = 38cm), Table 4.

**Table 3.** Quantitative body measurements of Caraga black native chicken.

| Morphological Characteristics | Genetic Group of Philippine Native Chickens | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Patani | | Zampen | | Boholanon | | Camarines | | Darag | |
| | R | H | R | H | R | H | R | H | R | H |
| Plumage | Black | Black | Black w/ Red | Black | Wine Red | Red | Yellow-Orange | Brown | Red | Yellow-Brown |
| Plumage Pattern | Plain | Plain | Plain | Plain | Plain | Laced | Bared | Laced | Plain | Laced |
| Body Carriage | Upright | Upright | Upright | Upright | Slightly upright | Slightly upright | – | – | Slightly upright | Slightly upright |
| Comb Type | Single | Single | Pea | Pea | Single | Single | Single | Single | Single | Single |
| Comb Color | Black | Black | Red | Red | Red | Red | Red | Red | Red | Red |
| Earlobe Color | Black | Black | Red | Red | Red | Reddish White | Red | Red | White | White |
| Shank Color | Black | Black | Yellow/ Gray | Gray | White | Yellow | White/ Gray | White/ Gray | Gray | Gray |
| Skin Color | Black | Black | White | White | White | White | White | White | White | White |
| Iris Color | Dark Brown | Dark Brown | Orange | Orange | Orange | Orange | Orange | Orange | Orange | Orange |
| Beak Color | Black | Black | Black | Yellow | Black | Yellow | White | White | White | Gray |

Legend: R = Rooster, H = Hen

**Table 4.** The Quantitative body measurements of the five genetic groups of Philippines native chickens.

| Morphological Characteristics | Genetic Group of Philippine Native Chickens | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Patani | | Zampen | | Boholanon | | Camarines | | Darag | |
| | R | H | R | H | R | H | R | H | R | H |
| Body Weight (kg) | 1.9 | 1.35 | 1.29 | 1.1 | 0.82 | 0.75 | 1.1 | 0.9 | 1.50 | 1.2 |
| Height (cm) | 28.5 | 23 | 24 | 24 | 21 | 20 | 26 | 22 | 24 | 20 |
| Body Length (cm) | 24 | 19.5 | 43 | 39 | 35 | 34 | 21.3 | 17.4 | 43 | 38 |
| Wingspan (cm) | 77 | 64 | 45 | 41 | 42 | 41 | 41 | 41 | 49.5 | 41 |
| Shank Length (cm) | 10.5 | 8.25 | 11 | 9 | 9.7 | 9.5 | 7.1 | 5.6 | 11.6 | 8.6 |
| Chest Circumference (cm) | 33.5 | 30 | 31 | 29 | 24.6 | 24 | 25 | 23 | 31 | 28 |

Aside from Patani, two chickens exhibit fibromelanosis or hyperpigmentation. The Silkie chicken of China and the Ayam Cemani of Indonesia. The Silkie chicken has been a melanocyte precursor and neural crest migration model. The selkie breed is believed to have been established before the 13th century (Haw, 2006).

Unlike Patani, Silkie chicken is named for the hair-like appearance of adult feathers. Silkie pigmentation is found extensively in the dermal layer of skin, sheaths of muscles and nerves, tendons, gut mesenteries, blood vessel walls, trachea, and air sacs (Kuklenski, 1915; Hutt, 1949; Faraco *et al.*, 2001; Dorshorst *et al.*, 2010). According to Hutt. 1949, 2 genes control 1949, the hyperpigmentation of Silkie chicken, autosomal dominant fibromelanosis ($Fm/fm^+$) and the sex-linked incompletely dominant inhibitor of dermal melanin ($Id/id^+$).

It was found that $id^+$ allows pigment of the shank in the dermal layer of skin, and junctions with Fm cause the hyperpigmentation in the Silkie chicken. The hyperpigmentation phenotype of the Silkie chicken is believed to be caused by abnormal migration and proliferation of NCCs, the multipotent precursors of the melanocyte, in the developing embryo (Lecoin *et al.*, 1996; Reedy *et al.*, 1998; Faraco *et al.*, 1998; Dorshorst *et al.*, 2010). Endothelin 3 (EDN3) as a candidate gene for FM and beta 1, 4- Galactosyltransferase, polypeptide 1 (B4GALT1), and version (VCAN) as candidate genes for Id (Dorshorst *et al.*, 2010).

Ayam Cemani is a breed of chickens with characteristics of black plumage, comb and wattles, beak, eyes, skin and legs, and even black internal organs, bones, and muscles. Ayam Cemani is raised for eggs and meat to meet domestic market needs. In Java, Ayam Cemani is used in ritual ceremonies and folk medicine to treat cardiovascular and respiratory diseases (Muryanto. 1991, Iskandar *et al.*, 2005; Lukasiewicz. 2015; Dharmayanthi *et al.*, 2017).

Ayam Cemani also exhibits fibromelanosis or dermal hyperpigmentation and possesses complex segmental duplications on chromosome 20 that involve the endothelin three genes, EDN3. A genomic region, DR1 OF 127kb, and another region, DR2 OF 171kb, were duplicated by unequal crossing over, accompanied by inversion of one DR2. The findings of the quantitative PCR and copy number variation analyses on the Cemani genome sequence show the EDN3 duplication. These genetic arrangements are identical in Cemani and Silkie, manifesting a single origin of the genetic cause of Fm. The two DR1s harbor two distinct EDN3 haplotypes in the form of permanent heterozygosity (Dharmayanthi *et al.*, 2017). Unlike the Silkie chicken of China and the Ayam Cemani, a study on the possible reason for the hyperpigmentation of the Patani is still unavailable. The findings on the morphological features of the Patani manifest similarity of the hyperpigmentation of the Silkie chicken of China and the Ayam Cemani.

## Conclusion

The result shows that the Patani possessed distinct traits among the five genetic groups of Philippine native chicken. The eumelanin on the morphological features of the Patani might be the reason for its distinctive characteristics. Moreover, the Patani rooster is heavier compared to the female Patani because males compete with one other for mates. Darwin claimed that the larger size of the males of most birds and mammals results from adaptation due to competition [13]. Furthermore, the possible causative agent behind the hyperpigmentation of the Patani might be similar to the causative agent on the hyperpigmentation of the Silkie Chicken and Ayam Cemani.

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