

Phenotypic Characterization of Indigenous Frizzle Feathered Chicken in Nepal

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Abstract

Phenotypic characterization of chicken is important for differentiating them among the breed and to understand the role of these phenotypic traits on body performance. Phenotypic traits like body plumage color, morphology of feathers, shank size, shank color, ear lobe and eye color, different comb and their size etc. are noted for characterization of indigenous chickens phenotypically. The indigenous chicken breed i.e., Sakini, Ghati khuile, Pwankh ulte of Nepal, which also have a major role in back yard poultry can be differentiated based on phenotypic characters. Indigenous frizzle feather differs from the other two having typical curled (frizzled) plumage. The skin color varies from yellow to pink, shank color yellow, red earlobe, eye color varies among males and females of these breeds and they have a single rose comb with comb color usually red /pink. These chickens are on the verge of extinction and need urgent works related to their conservation.

Keywords: Frizzle Feathers, Indigenous, Phenotypic Characters, Poultry, Reeds

Introduction

Nepal being highly geographically diversified with great variations in climate, topography, and socio-economic factors and this has given the privilege of livestock farming in all regions of the country, including the Mountain, Hill, and Terai belts (Pradhanang *et al.*, 2015). The poultry production industry accounts for about 3.5% of total GDP (Dhakal *et al.*, 2019) and 17.4 percent of total meat production in the country (Sapkota *et al.*, 2020). In 2018, the production of poultry meat for Nepal was 60,402 tons. Production has increased from 4,106 tons in 1969 to 60,402 tons in 2018 with an average annual growth rate of 6.53% (*Nepal Production of Poultry Meat, 1961-2019*). In the case of Nepal, poultry farming can be best to enhance the livelihood of people as it can give good income. The majority of rural people are benefitted from chicken rearing. Not only meat and egg but the obtained poultry manure has its great potential use in the agriculture field (Osti *et al.*, 2016; Dhakal *et al.*, 2019) leading to the fast growth of the poultry industry in the country.

Domestic fowl (*Gallus domesticus*) are the most common poultry, followed by pigeons (*Columba livia*) and ducks (*Anas platyrhynchos*) when it comes to the poultry industry in Nepal (Wilson, 1997). Local breed (Sakini, Pwankh ultey, Ghanti khuile), synthetic breed, and pure breed are the breed types of poultry breeds raised in Nepal (Mishra, 2013). Nearly 45% of the total poultry population of Nepal is contributed by indigenous poultry breeds. Even under low input production systems, poor nutrition, they adapt well with considerable tolerance to disease (Acharya & Kafle, 2015). According to FAO, exotic breeds like New Hampshire, Rhode Island Red, White Leghorn, Australorp, Black Minorca, and other synthetic breeds have been introduced in Nepal and thus more intensive management systems with adequate housing, nutrition, and health control is required for their rearing (Dhaubhadel, n.d.). Different chicken breed differs both genetically and phenotypically and these characters make them unique. Morphological traits like shank color, feather type, comb types and ear-lobe color show variations, and these are very common among the indigenous chicken populations (Tadele *et al.*, 2018). Generally, Sakini is taken as reference to all local chickens but this breed is also not uniform in many aspects as a large percentage of naked neck fowls while some of the birds have frizzle feather genes (Wilson, 1997). Frizzle chicken is one of the indigenous chicken of Nepal. Curled or frizzled plumage is the major characteristics of Frizzle breed chicken. The phenotypic characterization of the feather governed by the frizzle gene makes the breed distinct from other indigenous poultry breeds ("Frizzle (Chicken Breed)," 2020). These frizzle feather chicken also known as "Dumse" or "Pwankh Ulte" are found throughout the country in a smaller number than the Sakini breed. These are hardy breeds with dual-purpose i.e. used for both meat and egg production (Siddiky, 2018) and these breeds are on the verge of extinction and are categorized as endangered species.

Materials and Methods

The methodology while writing this article has mainly emphasized to outline the considerable works and efforts of various researchers who have carried out their works in the case of Frizzle feather chicken but the major focus was given to research work/ journals, article which were related to indigenous frizzle feather chicken breed of Nepal. Relevant information from different journals, articles, books, websites about frizzle chicken, and its phenotypic characterization in the case of Nepal and the world were collected and have been compiled in this review.

Major Findings

Indigenous Poultry Breeds of Nepal

Indigenous breeds also known as local breeds can be defined as the breeds which have been in a country for a sufficient period to be genetically adapted to the environment or traditional production system of that country as defined in the Animal Production and Health Report of Regional Workshop published by FAO (2014). The rearing of Indigenous breeds of chicken represents a "balanced farming system" having a greater role in enhancing rural economy. Their hardy nature, ability to tolerate the harsh environment, and good performance even with poor husbandry practices have encouraged farmers to rear them even if they grow slowly and lay small eggs (Dessie *et al.*, 2011). These native birds lay optimum eggs, grows to optimum size even under harsh environments which are farmers priority when it comes to poultry farming. It gives to livelihood security, food security, and economic security employing youths and women. Also conserving the native breeds provides genes that allow improving the exotic high yielding breeds/germplasm for better adaptability and tolerance against the disease as they are the reservoir of genomes (Padhi, 2016). Backyard poultry in Nepal is famous for rearing Indigenous breeds (reservoir

of huge genome) which mainly consists of Sakini, Ghati khuiley, Pwankh ulte, ducks and turkey etc. They are preferred for their meat taste. Rearing of Indigenous breeds have provided many socio-economic advantages of which rise in income, tolerance to disease, pests, good source of protein obtained through meat and egg, poultry manure for agriculture are some of them (Uddhav *et al.*, 2016; Kattel, 2016; Sapkota *et al.*, 2020). To date, these indigenous breeds have been categorized phenotypically and the wide use of exotic breeds for their dual-purpose are some reason for the decline of Ghati khuile, Pwankh ulte in Nepal (Dhakal, *et al.*, 2020). Some of the production performance characters in the case of the indigenous breeds of Nepal are given below as:

- The average BYP size is 5-10 per household with a maximum of 50.
- At 24-30 weeks of age (8-10% never lay) hens start laying
- 40 gm is average egg weight
- Produce average 2-4 clutch/year; average 12 eggs/clutch.
- 70% eggs hatch; 9 chicks/clutch hatch.
- Only 40% of chicken hatched reach adulthood 80% of these losses occur in the first 4 weeks of age.
- Weight gain: At - 2 months - 0.5 kg.
- Adult – rooster at 4 months 2 kg
- Hen at 6 months 1.3 kg

Source: (Kattel, 2016)

Phenotypic characterization of Chickens

According to a guideline on Phenotypic Characterization of Animal Genetic Resources, given by Food and Agriculture Organization of the United Nations, (2012) phenotypic characterization of food and agriculture has been defined as the process of identifying distinct breed populations and describing their external and production characteristics in a given environment and under given management, taking under consideration the social and economic factors that affect them. Some of the points that are to be undertaken when it comes to studying phenotypic characterization for collection of various data and the points to be taken into consideration are described as below:

- Population size and structure, if possible, otherwise note the geographical distribution data
- Phenotypic characteristics of the breeds including physical features and appearance, economic traits (e.g., growth, reproduction and product yield/quality), and some measures (e.g., range) of variation in these traits
- Note: the productive and adaptive attributes of the breeds should be given major focus
- Images of herds or flocks in their typical environment together with images of the adult males and females of the breed
- Information regarding the origin and development of the breeds
- Any known functional and genetic relationships of the breed with other breeds outside or within the country
- The biophysical and management environment(s) in which the breeds are maintained;
- Breeds respond to different environmental stresses or complexes such as extremes of climate and poor feed quality, disease and parasite challenge, along with any other special characteristics related to adaptation
- Management strategies used by communities also known as indigenous knowledge to utilize the genetic diversity in their livestock

Using phenotypic traits we can characterize indigenous chicken (Hutt, 1936) and the use of multivariate analysis is an effective statistical tool when indigenous birds are to be characterized and differentiate phenotypically (Selolo *et al.*, 2015). For the phenotypic characterization of chicken measurements like feather morphology, color of body plumage, beak color, body weight, shank length, color of shank, skin, eye, ear lobe along with comb are noted. And if the chicken has special characteristics like naked neck, beard and muffs, polydactyl, frizzle, or silky feather then such characteristics are also noted (Laenoi *et al.*, 2015) in which data were collected following the guidelines about Phenotypic Characterization of Animal Genetic Resources given by FAO (2012). Phenotypic characters are important for study as there can be a correlation between the performance of chicken and its phenotypic traits. In a study done by Tabassum *et al.* (2015) in the indigenous chicken revealed the significant influences of some phenotypic characteristics on the pelvis width and body weight i.e.. comb-type significantly ($p < 0.05$) affected body weight and pelvis width of the chickens.

In the case of frizzle feather chicken, phenotypic characterization is also based on morphological traits. Various experiments are carried out to see the significance of these traits with other chicken breeds. Experiment done by

Sholeh *et al.* (2020) showed the significant differences between the head and feathers of wild type and frizzle feather chicken which were chosen for the study. Frizzle chicken had longer head length and beak length compared to wild type. Similarly, the size of head diameter and eye diameter were found longer in wild types than that of frizzle chicken. The feather weight of frizzle chicken was greater than the wild type. Such an experimental study is important for differentiating the chickens and the influence of their morphological traits on their performances.

Frizzle Feather Chicken

On a question about “What is a Frizzle Chicken?” (2013), Wikipedia states that a frizzle feather chicken is a unique bird among the poultry species having its curly feather directed outwards in all directions thereby giving the chicken the mop look. It is recognized in European countries and Australia as a distinct breed. The breed has rounded full breast and short brood bodies. Frizzle feathers are abundant in neck, feathers are absent in legs while feather on the body shows ragged appearance. The breed appearance can be found in many colors like white, black, buff. These chickens are used for dual purposes. The kinds of plumage found in these breeds are frizzled, over frizzled, and flat-coated. Whatever the color of the breed is, its eyes are red-colored, have medium-sized red-colored ear lobe, bright red colored wattle. The dark feathered frizzle birds have darker legs. The beak color varies with feather color. The breeds are hardy with gentle temperament. The average bodyweight of the male bird is 3.2-3.6 kg while a hen weighs about 2.25-2.7 kg. According to Frizzle chicken characteristics & breed information, (2016), these types of breeds are well adapted to all types of climates which is also depicted by Lowney (2020). The phenotypic characters as mentioned can be summarized in the following table as:

Table 1: Frizzle feather chicken breed profile

Breed size	Large
Broodiness	Frequent
Comb	Single
Egg color	White or tinted
Egg size	Medium
Egg Productivity	Medium
Feather Leg	No
Climate tolerance	All climate
Varieties	Any recognized color
Breed Temperament	Gentle, docile, easily handled

Source: Lowney, (2020)

As frizzle feathers turn outward relative to the skin, whereas the normal body and flight feathers have a dorsal orientation which tells that there is a difference in rachises of frizzle and normal feathers. Some modifications like thickening of barbules and barbs, alteration of the hooklets, etc. are displayed as the irregular appearance of rectrices and remiges in the frizzle feather chicken but they are less affected (Landauer & Dunn, 1930; Hutt, 1936). The experiment was carried out by Ng *et al.* (2012) by conducting a scan of whole-genome linkage and the causative genetic mutation was mapped to the linkage group E22C19W28_E50C23. The cause of F mutation was caused by a deletion in a conserved region of α -keratin when the candidate genes in the associate interval were analyzed during the experiment. Muted k75 protein or a retrovirus-mediated misexpression of the wild type was found to be the causative effect of the KRT75-MT in the feather follicle during the regeneration in chicken with normal plumage. The experiment also supported the fact about the role of KRT75 in the development of the feathers. According to Landauer & Aberle (1935), the defective plumage in the frizzle chicken may be responsible for the increased loss of heat from the body, leading to the acceleration of the basal metabolism which again is responsible for the alteration in the size of the organ and with numerous physiological abnormalities. In another experiment carried by Dong *et al.* (2018) in Kirin chicken (which is also a Chinese indigenous breed noted for its frizzle feather), showed that the mutation of the KRT57L4 gene is responsible for the frizzleness of the feather.

Indigenous Frizzle Feather Chicken (Pwankh ulte)

Indigenous Frizzle feather chicken is also known as "Dumse or Pwankh Ulte". The typical outward growth of

feathers i.e., frizzle feathers of this chicken make it phenotypically distinct. They are a dual-purpose breed i.e. used for both meat and egg, have ruffled feathers, and are found throughout the country in small numbers. Male weights 1.0 kg in an average while it female weights about 0.9 kg in an average. As they are in small number immediate action should be taken for their conservation, ("Poultry in Nepal" 2013, Siddiky, 2018). Genetic potential and the environment in which chickens are reared like feed, healthcare, shed, ecology are the factors that influences their productive and reproductive performance (Sapkota *et al.*, 2020). Morphological body parts, their measurement, and production performance character of Frizzle feather chicken/ Dumse/Pwankh Ulte according to Siddiky (2017) is given in Table 2 and 3 respectively.

Table 2: Morphological Body parts measurement of Frizzle chicken of Nepal.

Traits	Pwankh Ulte (Frizzle Feathers) chicken	Reference
Body length	16.2 ± 0.70	
Wither height	27.2 ± 1.13	
Color of Skin	Yellow, pink, white	
Color of shank	Yellow	
Type of comb	Single rose comb	
Comb color	Red/Pink	(Silva <i>et al.</i> , n.d.)
Feather color pattern	Solid, Barred, Laced	(Silva <i>et al.</i> , n.d.)
Eye color	Males are with Bown+black. Females are present with Orange+black, Yellow+black, and brown+black	(Silva <i>et al.</i> , 2016)
Ear lobe color	Red	(Silva <i>et al.</i> , 2016)
Color of Egg	Brown	

Source: (Siddiky, 2017)

Table 2: Production performance of Frizzle chicken of Nepal.

Traits	Pwankh Ulte (Frizzle Feathers) chicken
Bodyweight at 8 weeks (gm)	400-600
Bodyweight at 1st lay (kg)	1.0±0.04
Age at 1st lay (days)	176±3.9
Egg production/hen/year (no)	176±3.9
Egg weight (gm)	40-45
Adult weight (kg)	Male:1.9±0.03 (1.7-2.5), Female:1.6±0.03 (1.4-2.2)
Hatchability (%)	80±4.1

Source: (Siddiky, 2017)

Conclusion

The frizzle feather chickens have been characterized phenotypically in Nepal. Like other indigenous chicken breeds, these frizzle feather chicken breeds also play importance role in back yard poultry and help in alleviating poverty. They are the good supplement of protein and a good source of income as they can grow even in poor management system. So extensive plans, policies, research works should be given priority to conserve these frizzle feather chicken breeds of Nepal along with improving their morphological and performance traits through advanced breeding programs.

Future Prospects

Hence, after having a thorough study of several journal papers, articles, books related to indigenous frizzle feather chicken it can be said that there has been less study to this date in the context of Nepal while much more research related to frizzle chicken can be found in other countries. Learning from research works around the world in the case of frizzle feather chicken, we can proceed with such research activities in our country too. The native breeds are huge reservoirs of genes and they play a vital role when it comes to improving breeding lines. Good traits of the

breed like, its hardy nature, ability to tolerate diseases, stress environment should be recognized well in the breeding programs to improve these indigenous breeds. Crossbreeding programs, research works in genomics of chicken breeds, timely surveys should be carried out to monitor the breed number throughout the country, so that further research works, conservative efforts could be carried out efficiently. As people are still attracted to rearing these indigenous frizzle feather chickens, research works should be emphasized at government level too. Amendment of government plans and policies, proper allocation of budget to the research sector are some other measures to be carried out for the conservation of indigenous frizzle feather chicken breeds. Hence this article tried to open up the prevailing condition of indigenous frizzle feather chicken breed and encourage more research works for the conservation of these breeds.

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Conflict of Interests

There is no conflict of interest.

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