Connections among Local Nomenclature, Phenotypes and Genetic Characteristics of Native Chickens in Cambodia: A Synthesis

Phem Menghak[1*], Mizeck G.G. Chagunda[1]

[1] Department of Animal Breeding and Husbandry in the Tropics and Subtropics (490h), Institute of Agricultural Sciences in the Tropics (Hans-Ruthenberg-Institute), Hohenheim University, Garbenstraße 17, 70599, Stuttgart, Germany, [*]menghak.phem@uni-hohenheim.de

Abstract

Currently, there is little existing comprehensive information on Cambodian native chicken (CNC). Further, there is no coordinated phenotypic recording. Predominantly, CNC is known by its local names. However, information linking local names to phenotypic and genetic characteristics of CNC is sparse making phenotypic characterization of these genetic resources difficult. The current study aimed to establish the connection between the local nomenclature of CNC, with their phenotypic and genetic characteristics through a synthesis of some key literature, both published and unpublished. The synthesis involved 7 research articles, one FAO technical report, and local grey literature. Results showed that in terms of nomenclature, CNC are named based on their plumage color and other appearance characteristics such as frizzled and small-sided feathers. There was differing degrees of agreement between local names, phenotypic and genetic characteristics. It is therefore important that the native chickens be phenotypically and genetically characterized incorporating indigenous knowledge in order to initiate a platform for a designed breeding program.

Introduction

In Cambodia, livestock contribute 11.4% to national GDP (MAFF, 2021). The chicken population is approximately 50 million, of which 65% are raised in smallholder farms. The majority of native chicken breeds (98%) are in small flocks of less than fifty birds per household. The remaining 35% of chicken is imported commercial layers and broilers that are reared in intensive systems. Raising native chickens provides a source of food protein, helps farmers to generate other household income, avoids complete dependence on natural fishing, and allows women to earn extra income. The native chicken in Cambodia is also mostly used for ritual and cultural activities. This is despite that the native chicken has low productivity, raised in a poor management system with a high mortality rate due to diseases (Siek et al., 2016). Among local consumers, the native chicken is preferred to the exotic breeds. In most parts of the world, local chickens have different names based on different reasons. Predominantly, the names are derived from appearance, behavior, use, region, and general human perception. However, from a local community acceptance, CNC was named based on their plumage color, feather types and a special characteristic such as frizzled feather. Information linking the local names to phenotypic and genetic characteristics of CNC is never explained. Therefore, the current study aimed to establish the connection between local nomenclature, phenotypes, and possibly genetic characteristics of CNC through a synthesis of some key literature, both published and unpublished to deliver key information for the future breeding plan.

Methods

All research findings and national and international databases, both published and unpublished on native chicken in Cambodia, were reviewed. The review synthesized all relevant information on a production system, external/phenotypic and genetic characteristics from 7 research articles, one technical report from the Food and Agricultural Organization of the United Nations (FAO), and

chicken databases from a local institution report. There are external characteristics of chicken adapted from the local knowledge and language.

Results

Classification of Chicken breeds.

In Cambodia, chicken breeds were categorized into native/local breeds, commercial broilers and layers and crossbreds (Sun, 2018). Very few smallholder farmers used exotic breeds (2-3%) (MAFF, 2021). However, there were a few smallholder producers who had crossed their native line with the commercial lines and fighting cocks from local commercial distributors mainly Thailand, Vietnam. The native breeds were all raised mainly for both meat and egg and in general, the local term is "Moarn Khmer or Moarn Sre" which means Khmer chicken or indigenous. There is no comprehensive information on native breeds' identities and specific region distribution, the external characteristics are non-descript types varied in plumage color, comb type, shank length and body weight. Sann and Chhum (2004) described eight breeds (ecotypes) with brief external phenotypes summarized in Table 1. In addition, there is another local nomenclature called "Khmao" which means completely black feather, the breed also varies in body size, shank and skin color. Among all ecotypes, Sampov, Kandong, Skuoy and Kragnas accounted for 55%, 10%, 7%, and 5% respectively, similarly to Sun (2018) mentioned that Sampov accounted for the largest population in the country. Based on the available references, native breeds were most classified by their plumage colors, feather types (frizzle, naked neck), and matured size, except for Red Jungle Fowl and fighting cock. However, the local nomenclature has utilized these external traits to differentiate the native chickens and within the country, people have accepted the names of the native chickens though some characteristics are not distinguished. Future breeding plans may need to include and conserve the local nomenclature and external traits such as plumage, skin, color, shank color.

Table 1 The external characteristics of Native Chicken.

Local name	Adjusted English name by author[1]	Characteristics adapted by author
Moarn Prey	Red Jungle fowl	- Wild chicken (Gallus Gallus) with wild color feather
Sampov	Sailing ship	- Large body size and its name refers to the ancient sailing ship, colorful (black, wild, silver, gold, white)
Skuoy	Adlay plant/Barred feather	- Large body size, sex-link barred feather/color
Kandong	No tail/less feather	- Large body size, less body feather, no main tail feather, colorful (black, wild, barred, silver, gold, white)
Kragnas	Frizzle feather	- Large/small body size, frizzle feather and tail, colorful (black, wild, barred, silver, gold, white)
Samley	Cotton wool	- Small body size/white dwarf bantam, white feather-like cotton
Moarn Cher	Comb, small size	- Dwarf local chicken/dwarf bantam, has large single comb, colorful (wild, white)
Moarn Chul	Fighting chicken	- The female identity was hidden, the male is noted by the shank color (yellow, and dark green), shank and spur characteristics - Colorful (Wild, black, gold, white), fighting behavior

Source: Adapted by author from Sann and Chhum (2004)

[1] The adjusted names based on the local expert knowledge

Phenotypic characteristics of Native chickens in Cambodia.

In a natural-breeding population without selection, external morphologies of chicken are mixed up and complicated to identify both qualitative and quantitative traits of referenced breeds. Among the native breeds, Khmao and Skuoy were easily identified by the black and barred feathers respectively. However, some ecotypes might not be phenotypically classified as a different breed due to their non-descript characteristics such as qualitative phenotypes; colorful plumage, unidentified skin, shank, earlobe color, comb type, and quantitative phenotypes; body weight, and other growth traits, and egg production traits. Some local nomenclatures referred to feather structures (slow-growing, frizzledness, naked neck), which these phenotypes may occur in any populations under natural selection for adaptation to the external environment. According to FAO (2009), body weight and shank length distribution of the native chicken were different between male and female, and agro-ecologic zones. The male chickens had heavier and taller or larger body sizes than the female, particularly the chickens in the central plain indicated the highest weight, and the smallest ones found in the coastal region but taller than the chickens in highland. The major shank color was yellow representing 50% of the total, and white and yellow skin was 50% and 35% respectively in all regions, regardless of coastal zone which had the highest yellow skin and shank color up to 60% of the total. The results illustrated differing ranges of agreement between the local names and the phenotypic characteristics of all recent ecotypes identified and accepted as breeds by the local communities. Therefore, there should be more described phenotypic traits to name the chicken breeds also they may differentiate by adapting to different agro-ecologic zones.

Table 2 Comparison of body weights and shank length in different regoins.

Sex	Costal	Central plain	Highland
Body Weight (gram)			
Males	1 322	1 719	1 469
Females	1 315	1 494	1 320
Shank length (centimete)			
Males	9.5	9.8	8.7
Females	8.6	8.4	7.3

Source: Adapted by author from FAO (2009)

Genetic characteristics of Native chickens in Cambodia.

The Red Jungle Fowl (Gallus gallus) occurs over a wide geographical range in Southeast Asia. According to a complete mtDNA D-loop study by Osman and Nishibori (2014), the Red Jungle Fowls (RJFs) from Cambodia showed higher diversity than those in Laos and Myanmar. Okumura et al. (2006) illustrated that native chicken populations in South-East Asia are genetically similar including Thailand, Laos, Myanmar and Indonesia due to closed distance and random mating. Nishibori et al. (2006) conducted a genetic diversity study from 2245 native chickens in 17 provinces in Cambodia. The genes considered for morphologic traits; plumage colors, shank colors, comb types were studied; the gene frequency of the loci of CNC except one showed a similar tendency to those of Thai native chickens, particularly those from Ratanakiri province. For dominant white plumage color (I/i locus), the frequency of the I allele was very low (0.007) than that of other Asian countries. In contrast, extend black plumage color (E/e+/e), the frequency of the E allele was higher than Asian countries (0.31), and the frequency of e+ was higher and e was lower than in Asian counties. For shank color, the gene frequency for yellow/white was slightly lower than Asian countries except for China, and females presented higher than males did. On average, this finding was similar to phenotypic frequency (50%) by FAO (2009) but quite low in a few provinces around the capital city where there are high numbers of commercial chicken farms. Cambodian native chickens could be regarded as the first to be domesticated and may share similar genetic resources to

those in South-East Asian and Asian countries. Among the native population, they may be genetically different due to natural and artificial selection. Recently, Thailand conserved 4 native chicken breeds and was named them based on plumage color, utilization and main region distribution (Dorji et al., 2011). These studies all suggested a further study on genetic characterization with the relevant breed name, phenotypic characteristics, breed utilization in different agro-ecological zones. Connections among local nomenclature, phenotypes and genetic characteristics of native chickens would be informative in designing breeding plans for improvement, preservation and exploiting the genetic diversity.

Conclusion

Cambodian native chicken breeds are most classified by their plumage colors, feather types (frizzle, naked neck), and matured size by the local nomenclature. Where quantitative information is available, body weight and shank length vary in different sexes and agro-ecological zones. Genetically, CNC is highly diverse. Local nomenclature utilizes external traits to differentiate the native chickens although some characteristics are not clearly distinguished. Future breeding plans may need to include and conserve the local nomenclature although robust phenotypic and genetic characterization will be required.

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