

Analysis of Morphological Traits for Comparative Studies in Domestic Chicken Populations

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Abstract for the poster presentation:

Phenotypic variation provides a source of information to assess population differentiation in chickens. For this purpose, phenotypic measures, i.e. wing length (forearm), shank length (metatarsus), shank thickness, keel length and live weight were collected on a minimum of 10 chicken per sex, in total 986 individuals, from a sample of 43 fancy chicken populations. The populations range across seven groups for regular sized chicken breeds and the first two groups for bantam specified by the breed standard of Germany (2010) for fancy breeds.

To describe the body proportion and shape of chicken breeds, following traits were defined as ratios of measures: shank shape (shank length/shank thickness), limb form (shank length/wing length), body proportion (keel length/shank length) and body form (weight/volume generated by keel length cubed). Scatterplots of population means for each trait ordered by size were scanned for formation of groups with similar behaviour among the populations and stepwise differences between the groups. Correlations of population means were estimated for all traits and a principal component analysis (PCA) was undertaken to identify factors of high differentiation ability between populations.

The population means formed graphs with continuous increase for all traits, revealing no stepwise pattern that would suggest an underlying genetic effect due to a single gene or small number of genes. The slope of the curve should become smoother with including further populations of intermediate measures. Overall, the continuous distribution of measures with large overlaps across examined populations suggests that single populations are not genetically isolated but part of the pool of chicken populations. Only the extremes in shank length, i.e. Chabo and Malay, were identified as significantly different from the other population means in shank length and body proportion.

The correlations between measures of each side of chicken, i.e. right and left wing length, shank length and shank thickness were as expected close to one. Strong relationship was revealed between wing, shank and keel length as well as keel length and weight while shank thickness, excluding booted populations, showed the weakest correlations with the other measures. The inferred traits from ratios were less strongly correlated with any measure, showing tightest relationship between body form and shank as well as keel length and no relationship between shank shape and shank thickness (booted populations excluded).

The first axis of PCA discriminates populations with larger bodies and weight and long limbs which is related to large chicken (Malay, Shamo, Brahma) from populations with small bodies and weight which is related to bantam (Chabo, Bantam, Sebright, Booted Bantam i.a.). The second axis separates populations on slender, delicate legs (Phoenix, Sebright, Bergische Kräher, Ostfriesische Möwen, German Bantam, i.a.) from those on dumpy legs (Indian Game, Chabo, Brahma due to their boots, Aseel). The PCA highlights the most differentiating phenotypic characteristics and provides a synthetic typology of the populations.