

Reexamination of the domestic chicken in ancient China

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Abstract

Through the re-analyses to the chicken bones unearthed from some archaeological sites and the trimming of the related researches, this paper pointed out that the past recognitions of the domestic chickens in ancient China were mostly questionable. Referring to the new research results and the new development in the verification methods of the ring-necked pheasant and chicken in recent years, as well as the verification of the chicken bones unearthed from the Shenmingpu Site in Xichuan County, Henan, this paper announced the importance of differentiating ring-necked pheasant and chicken from multiple skeletal parts based on the characteristics in the sense of skeletal morphology. Moreover, this paper emphasized that only with this as the foundation, the criteria for distinguishing the morphological characteristics of red junglefowl and domestic chicken can be established and the issue of the origin of the domestic chickens in China can be accurately and comprehensively discussed.

Keywords: Chickens–morphology–criteria; domestic animals–China–history; Late Shang Dynasty; zooarchaeology

Brief introduction of the issue

The origin of the domestic chicken is an exciting research topic for archaeologists and zooarchaeologists. Over the years, zooarchaeologists in China have made important contributions to research on chicken domestication. One of the most influential publications came out of a joint Chinese and British project during the 1980s. In their article in the *Journal of Archaeological Science* (1988), West and Zhou argued that the world's earliest record of domestic chickens were found at Cishan Site

in Wu'an, Hebei Province, China, which has radiocarbon dates placing it at ca. 6000 cal BCE. The evidence from Cishan Site has long been accepted by international zooarchaeological circles as the earliest evidence for domestic chickens and is even cited as the earliest evidence for chicken domestication in the most recent edition of the standard textbook *Zooarchaeology* (Reitz and Wing 2008: 292).

However, recent progress in zooarchaeological research on chicken remains—especially in determining differences in morphological characteristics between the common pheasant (*Phasianus colchicus Linnaeus*), red junglefowl (*Gallus gallus Linnaeus*), and domestic chicken (*Gallus gallus domesticus* Brisson)—questions the conclusion that Cishan contains the earliest evidence for chicken domestication. The chicken remains from Cishan as well as domestic chicken bones from many Neolithic sites in China need to be reexamined and further analyzed.

Review and reflection

There is a common saying in China that states “*wugu fengdeng, liuchu xingwang* 五谷丰登、六畜兴旺” (an abundant harvest of the five grains, a thriving of the six domestic animals). This saying originates from the Confucian classic *Zuozhuan* 左传 (Zuoqiu Ming's commentary to the Spring-and-Autumn annals), a chronicle historiography recorded the history of China during 722-468 BCE. In the text for the 19th year of Duke Xi of the Lu State (641 BCE), it was stated that “anciently, the six domestic animals were not used at the same sacrifice [古者六畜不相为用. The English translation adopted from that of Legge, James]”. The six traditional domestic animals in China are horses, cattle, sheep/goats, pigs, dogs, and chickens. Due to their mention in *Zuozhuan*, it appears that all six of these animals were already domesticated in China by at least 641 BCE.

In light of the textual evidence, we can take 641 BCE as a starting point and work backwards in time to determine the origin of domestic chickens. Sorting through previous publications on chicken domestication, including 38 Neolithic and Bronze Age sites where chicken bones have been identified, we find that most publications making claims about early chicken domestication do not contain evidence from zooarchaeological analyses. Most reports are pure conjecture or make conclusions about the status of domestic chickens without explaining the basis for their identifications. Additionally, researchers frequently assume that domestic chickens existed at a given site simply because domestic chickens had already been found at sites with earlier dates. We cannot help but question the

scientific accuracy of these identifications.

Within the few reports and articles containing more detailed analyses, researchers tend to rely on six main types of data to determine the domestication status of ancient chickens:

1. Morphological traits.

Certain morphological traits on bones can be used to identify domestic chickens. However, most previous researchers simply note that some skeletal elements appear very similar to either the wild red junglefowl or the domestic chicken but do not go further to provide specific anatomical traits that support their arguments about the domestication status of the bones they identify. We believe that simply stating that morphological characteristics appear similar to chickens is not rigorous enough and therefore find it difficult to make further judgments about the domestication status of most previously published cases.

2. Metric data.

At the Neolithic site of Peiligang in Xinzheng, Henan Province, researchers determined that excavated chicken tarsometatarsus bones are longer than those of red junglefowl (62-68mm). Therefore they believe that the bones from Peiligang belong to domestic chickens. However, recently Jing Yuan observed and measured three red junglefowl specimens at the French National Museum of Natural History. The museum identification numbers for the specimens are 1880-206, 1880-207 and 1884-2472 with lengths of 103.87mm, 102.61mm, and 80.8mm respectively. Therefore, using size to differentiate between red junglefowl and domestic chickens may be unreliable, especially because the natural size range of each species is not well understood. Because there can be a great deal of size variability within the same species,

using measurements to identify domestic chickens may lead to misidentification.

3. Archaeological context.

At the Beishouling Site in Baoji City, Shaanxi Province, excavators uncovered a pottery jar containing what was believed to be a chicken skeleton. Because it was found as part of a burial offering, excavators at the site speculated that this may have been a domesticated chicken. By looking through photos in the published excavation report, we believe that the tarsometatarsus of this specimen more closely matches that of a pheasant (Figure 1:1). The presence of cattle, pigs, and other medium-sized or large-sized mammals in burial contexts is often considered good evidence for domestication. However, with smaller, easier to capture birds, the presence of a single animal in a burial context is not conclusive evidence that it was a domesticated animal.

4. Sex ratio.

If we take Cishan as an example, one line of evidence used to argue that domestic chickens were present at the site is the fact that many more male chicken bones were identified than female chicken bones. It is important to note that many factors can cause biases in the types of bones excavated from a site including modern excavator bias as well as ancient cultural biases. Activities such as selective hunting or concentrated discard of certain animal bones may skew the sex ratio in the zooarchaeological assemblage. As is the case with the other lines of evidence listed above, an unbalanced sex ratio alone is not enough to conclude that chickens were domesticated.

5. Representations in artifacts.

Careful analysis of ceramic figurines unearthed from the Shijiahe Culture deposits of the Late Neolithic site of Dengjiawan in Tianmen, Hubei Province shows that among 40 figurines depicting various birds (and despite the fact that these artifacts were roughly produced and sometimes arbitrarily shaped) it is possible to identify the presence of chicken figurines based on characteristic traits such as a short beak or short tail. Figurines of other domestic animals including pigs and dogs as well as wild animals including elephants and monkeys have also been found. Therefore, we must be cautious when assigning species identifications purely based on such artistic representations because many types of animals including both wild and domestic species were depicted.

6. Historical texts.

There was undoubtedly a long period of time between the initial appearance of domestic chickens and the first written record of domestic chickens. We do not know how long this intermediate period was, nor can we directly use textual sources to investigate or trace the origin of domestic chickens back in time. Instead, we can only use textual sources to establish a last known date when fully domesticated chickens were present in China.

The six types of data summarized above have been used by zooarchaeologists to discuss the domestication and origin of domestic chickens. However, with the exception of morphological criteria, most of these lines

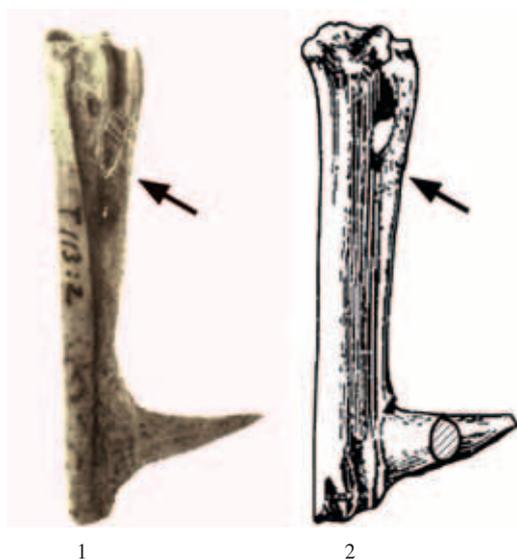


Figure 1 Tarsometatarsus.

1. Pheasant (male, Beishouling Site); 2. Pheasant (male, Dawenkou Cemetery).

of evidence only have limited applications. Therefore we urge researchers to always use multiple lines of evidence. Even using morphological traits to identify chicken bones can be difficult. In addition to the examples mentioned earlier such as Beishouling, we also have discovered several other cases where chicken bones have been misidentified. For example, published line drawings of a tarsometatarsus from the Dawenkou cemetery in Tai'an, Shandong Province more closely match that of a pheasant, not a domesticated chicken as is claimed (Figure 1:2). The bones of chickens and pheasants are very similar, so it is possible that other reports have misidentified chicken and pheasant bones as well. We suggest a thorough re-examination and re-evaluation of previous reports of domestic chickens in China. However, we do not refute the findings of all previous studies. For example, the report for the Yinxu Site of the Shang Dynasty in Anyang, Henan Province contains a detailed description of the traits that can be used to identify domestic chicken skull bones. Unfortunately, because it is very uncommon to find skull bones archaeologically, these criteria have not been applied at other Chinese sites. Although the chicken bones from Yinxu have been lost, we still believe they represent domesticated animals thanks to the detailed morphological descriptions given by past researchers.

New Advances in Morphological Studies

For zooarchaeologists, morphological criteria are the most basic and most important type of data used to identify animals. It is necessary to develop a series of standard criteria that can be used by all researchers to ensure the accuracy of future identifications. Researchers should also rely on multiple criteria and multiple lines of evidence when making claims about the domestication status of ancient animals. Recently, researchers in Japan have summarized morphological criteria that can be used to differentiate between the bones of common pheasants, red junglefowl, and domestic chickens (Eda and Inoue 2011). We tested these criteria on comparative collections at the Zooarchaeology Laboratory of the Center for Scientific Archaeology at the Institute of Archaeology, Chinese Academy of Social Sciences (IA, CASS) and found that four criteria are most useful for identifying domestic chicken bones. We describe them below:

1. Coracoid. A distinguishing feature is the presence or absence of the fossa on the ventral side of the bone close to where the coracoid attaches with the sternum (Figures 2:1 and 2:2). Red junglefowl and domestic chickens both lack this fossa. For bones with a fossa, judgments about whether a bone belonged to a pheasant can be made after observing the shape, size, and depth of the fossa.

2. Humerus. A distinguishing feature is the presence or absence of a small fossa on the ventral side of the distal humerus (Figure 3). A fossa frequently occurs in common pheasant and infrequently occurs in red junglefowl and domestic chicken. Cases where a fossa is absent have an over 80% chance of belonging to either red junglefowl



Figure 2 Coracoid.

1. Modern common pheasant; 2. Modern domestic chicken; 3. domestic chicken (Shenmingpu Site).



Figure 3 Humerus.

1. Modern common pheasant; 2. Modern domestic chicken; 3. Domestic chicken (Shenmingpu Site).

or domestic chicken. For cases where a fossa is present, additional observations of shape, size, and depth are necessary.

3. Femur. A distinguishing feature is the presence or absence of air pockets in the fossa on the greater trochanter (Figure 4). Air pockets on the greater trochanter are more frequently found in pheasant than in red junglefowl or domestic chicken. Therefore we believe



Figure 4 Femur.

1. Modern common pheasant 2. Modern domestic chicken 3. Domestic chicken (Shenmingpu Site).



Figure 5 Tarsometatarsus.

1. Modern common pheasant (female); 2. Modern domestic chicken (female); 3. Domestic chicken (female, Shenmingpu Site).



Figure 6 Chicken bones from Shenmingpua site.

that femurs without air pockets can be identified as either red junglefowl or chicken.

4. Tarsometatarsus. A distinguishing feature is the presence or absence of a ridge on the ventral side running between the proximal end and about two thirds of the way down the shaft. According to our observations of bones with completely fused epiphyses, those with a sharp ridge all belong to pheasants and those without a ridge all belong to either red junglefowl or domestic chickens (Figure 5).

The four criteria described above were based on

observations of a large number of specimens. However, using only one of these standard criteria as a basis of identification is not always reliable. We suggest that conclusions about archaeological cases will be most convincing when all four criteria are used together whenever possible.

Using these morphological criteria, we made observations of 125 bird bones found inside a bronze *ding*-tripod (Figure 6) from the early Western Han Dynasty (206 BCE-8 CE) cemetery site of Shenmingpu in Xichuan County, Henan Province. The site was excavated jointly by the Department of Scientific Archaeology and Archaeometry, University of the Chinese Academy of Sciences and the Henan Provincial Institute of Cultural Relics and Archaeology. We found that the bones belong to a single female individual and contain features characteristic of chicken bones (e.g., the absence of the fossa on the ventral side of the coracoid (Figure 2:3), the absence of the small fossa on the ventral side of the distal humerus (Figure 3:3), the absence of air pockets in the fossa on the greater trochanter of the femur (Figure 4:3), and the absence of the ridge on the ventral side of the proximal tarsometatarsus (Figure 5:3)). On the basis of the standard morphological features discussed above, textual evidence from the *Zuozhuan*, the fact that the bones represent a complete individual included as part of a funerary offering, and the presence of cut marks on some of the bones, we hypothesize that this individual is in fact a domestic chicken (*Gallus gallus domesticus* Brisson). Of course, ancient DNA analysis will provide a more definitive conclusion, but at this point the Shenmingpu offering contains the most complete and earliest evidence

for domestic chicken that we have found so far in China.

The chicken from Shenmingpu was identified using multiple morphological criteria and shows the feasibility of using such techniques for distinguishing between pheasant and chicken bones. However, red junglefowl and domestic chickens are very closely genetically related and we still need to further refine criteria that can be used to differentiate between these two species. At this stage we suggest two steps for continuing research on the origin of domestic chickens in China. First, we must lay the foundation for studying domestic chickens by determining which archaeological cases are definitively pheasants, especially the widespread common pheasant. These sites can then be separated from those containing chickens. Next, we must look within the *Gallus* genus for morphological traits that can help differentiate between wild red junglefowl and domestic chickens. We believe that only by following these two research steps can we more accurately and comprehensively identify excavated zooarchaeological materials.

Discussion

Because domestic animals are derived from wild ancestors, when exploring the origins of domestic animals we must consider the natural distribution of their wild progenitors. Currently, the international academic community agrees that chickens are a domestic species within the *Gallus* genus. Our current understanding of the natural distribution of wild red junglefowl is that these birds are primarily found in Indochina (as far west as eastern and northern India and as far south as Indonesia and Sumatra) and in the south and southwest of China. Given this distribution, we agree with Benxiong Zhou's argument (1984) that chickens may have been first domesticated in the Yangtze River Valley or further south. According to morphological criteria, the earliest definitive domestic chickens in the Chinese archaeological record come from the YinXu Site of the Shang Dynasty (ca. 1200–1046 BCE). Textual records confirm this finding because we know that chickens must have been domesticated before the Spring-and-Autumn Period (770–476 BCE). Therefore, based on the current information available, we conclude that chickens were fully domesticated by at least the late Shang Dynasty. It is very likely that chickens were domesticated prior to the Shang, but a lack of archaeological evidence from earlier periods prevents us from pushing back the date for the origin of domestic chickens in China at this time.

In recent years, the development of scientific techniques such as stable isotope analysis and ancient DNA analysis provide us with new ways to study animal domestication. We plan to incorporate isotopic and genetic data into future studies of chicken domestication to further

refine the standards used to identify domestic chickens in the archaeological record. Additionally, drawing from related disciplines such as ecology and animal geography will ultimately provide important insights to the origin of domestic chickens in China.

In conclusion, we plan to establish standards for the identification of the origin of domestic chickens in China in two ways. First, we rely on multiple lines of evidence including morphological traits, metrics, archaeological context, comparisons of sex ratios, and related information from textual sources to identify the presence of domestic chickens. Next, when possible we will carry out stable isotope and ancient DNA testing. Through further rigorous scientific studies we hope to make zooarchaeological research on chickens more consistent and our conclusions more objective.

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Postscript

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