UC BERKELEY McCOWN ARCHAEOBOTANY LABORATORY REPORT #84

Pachacamac Archaeological *Capsicum* seed analysis II

Written for: Dr. Peter Eeckhout and Tatiana Stellian, Université Libre de Bruxelles

Authors: Katherine L. Chiou and Christine A. Hastorf, University of California, Berkeley

Date: 12/31/2016

Background:

Since 2011, Katherine Chiou and Christine Hastorf have participated in a research program focused on the species-level identification of archaeological *Capsicum* seeds. The bulk of our work on identification is summarized in the 2014 article "A systematic approach to the identification of chile pepper (*Capsicum* spp.) seeds: Establishing the groundwork for tracking the domestication and movement of chile peppers through the Americas and Beyond" which outlines an identification methodology for domesticated *Capsicum* seeds (*C. annuum*, *C. baccatum*, *C. chinense*, *C. frutescens*, and *C. pubescens*) based on diagnostic attributes found in modern *Capsicum* seeds (Chiou and Hastorf 2014). This methodology has since been applied to the identification of various archaeological *Capsicum* seeds, including seeds from the Preceramic sites of Huaca Prieta and Paredones in Peru as well as the Nasca site of Estaquería and possibly Inca-period site of Pachacamac (Chiou et al. 2014). In 2015, responding to our request for examples of *Capsicum* seeds from current excavations at Pachacamac, Dr. Peter Eeckhout and Tatiana Stellian of the Université Libre de Bruxelles generously sent six seeds for identification (Chiou and Hastorf 2015). Due to variable states of preservation, not all seeds could be identified to species-level with certainty. Two seeds were identified with confidence as *Capsicum chinense*. A further two were thought to be *C. chinense*, while two displayed morphology related to both *C. chinense* and *C. baccatum* (one of these seeds also appeared similar to *C. frutescens*).

In Fall of 2016, two additional seeds were sent by Dr. Peter Eeckhout and Tatiana Stellian for identification. Both seeds are desiccated and in excellent condition, making them ideal candidates for identification. The contextual information related to the provenience of the seeds can be found in Figure 1.

PROYECTO YCHSMA-ULB

No. de Registro: 126-j/g-1B-Cx22
Material: Vegetal
Sector: B15
Fecha: 31/03/16
Unidad: 126
Investigador: TS
Cuadrícula: j/g
Capa: 1B
Comentario: Asociado al Cx22. Fuera de la cistro [sic]

No. de Registro: 126-j-2
Material: Vegetal
Sector: B15
Fecha: 31/03/16
Unidad: 126
Investigador: TS
Cuadrícula: j
Capa: 2
Comentario: Nivel inferior de la capa

Figure 1: Contextual information related to the two *Capsicum* seeds included in this study.

Methodology:

The procedure for photographing and measuring the seeds can be found in UC Berkeley McCown Archaeobotany Laboratory Report #77 available online at: http://archaeobotany.berkeley.edu/Research/LabReport/lab77/lab77.pdf (Chiou 2014). Seeds were photographed using an Olympus camera (model DP72) connected to an Olympus stereomicroscope (model SZ61). Measurements were taken using the Olympus program Microsuite. These measurements are included in Appendix 1.

Results:

(1) Seed ID: 126-j/g-1B-Cx22 (*Capsicum chinense*)

This seed, pictured in Figure 2, displays the classic morphological characteristics of a *C. chinense* seed including the circular shape (sphericity: 0.81) with a "fish mouth" and a large attachment scar opening with a high sphericity value (0.29). The testa of the seed is smooth, a characteristic of seeds from *C. annuum*, *C. chinense*, and *C. frutescens*. The beak prominence ranking (2) and beak angle (56°) also fall within expectations.

(2) Seed ID: 126-j-2 (*Capsicum baccatum*)

This seed, pictured in Figure 3, is characteristically *C. baccatum*. Features that suggest this identification include the oval shape, low beak angle (23°) and the tight reticulation pattern on the seed testa. This seed is also significantly larger than the previous example (15.48 mm^2 compared to 10.95 mm^2) which is consistent with our analysis of modern *C. baccatum* and *C. chinense* seeds.

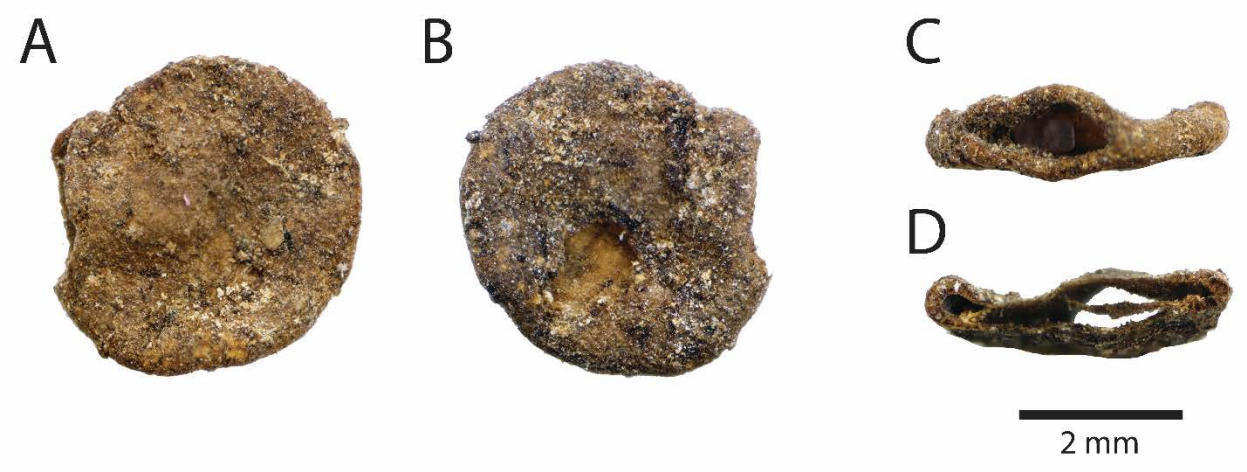

Figure 2: Photos of *Capsicum chinense* seed (ID: 126-j/g-1B-Cx22) showing (A) front view, (B) back view, (C) attachment scar view, and (D) transverse view.

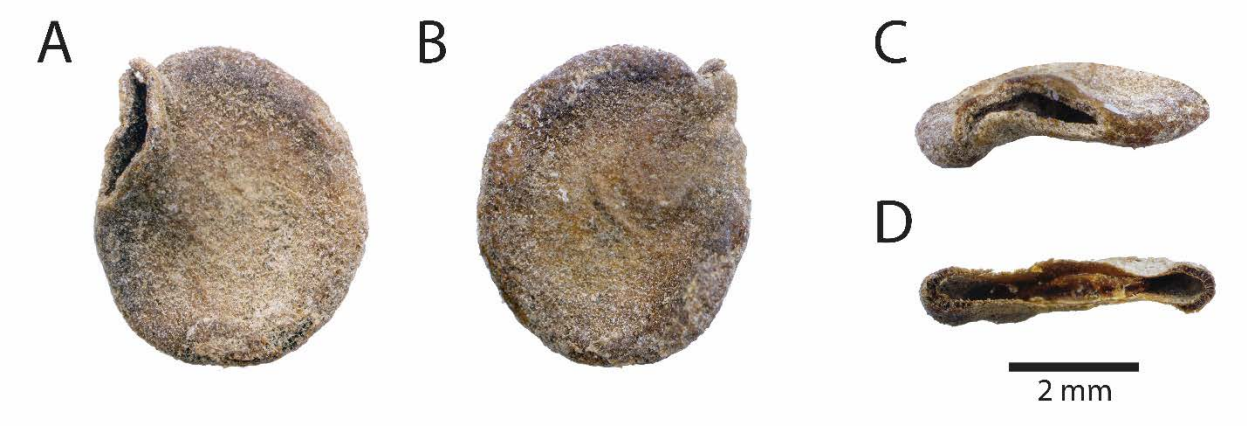

Figure 3: Photos of *Capsicum baccatum* seed (ID: 126-j-2) showing (A) front view, (B) back view, (C) attachment scar view, and (D) transverse view.

Discussion:

Capsicum seeds are commonly found at archaeological sites in the Peruvian coast and, as our research has shown, were a vital part of coastal cuisine over many millennia (10,000 years, Chiou et al. 2014). Our research thus far has indicated that while people in the coast were using chile peppers from multiple species early on (*C. baccatum*, *C. chinense*, *C. frutescens*. And *C. pubescens*), over time, it appears that these cultivars become more regionalized. For example, at Huaca Prieta, we observe a shift towards the exclusive consumption of *C. baccatum* (Chiou et al. 2014). In Katherine Chiou's work with Late Moche (AD 600-800) material in the Jequetepeque Valley in the north coast region, *C. baccatum* and *C. chinense* seeds were recovered in great

abundance. In Margaret Towle's collection at the Harvard University Herbaria and Botanical Museum, both *C. baccatum* and *C. chinense* chile peppers were included as part of the collection from the Nasca site of Estaquería. This increasingly indicates that in the past on the central South American coast, *C. chinense* and *C. baccatum* chile peppers became the two species that were utilized for food and flavoring.

Conclusion:

Today, *C. chinense* (ají limo type) and *C. baccatum* (ají amarillo type) peppers are commonly consumed in coastal cuisine. The secure identification of these two chile peppers from Pachacamac lends credence to the idea that both played a central role in coastal cuisine from north to south over thousands of years. The absence of *C. pubescens* (rocoto type) which is cultivated at higher elevations is intriguing, as thus far in our research program, we have not identified *C. pubescens* in the coast post ~9000 BP. It must be noted, however, that our sample size is still rather low, making these tentative conclusions as we increase our sample size. Nevertheless, the emerging patterns offer promising pathways for future research into coastal chiles and their place in the cuisines of the coastal inhabitants.

Bibliography:

Chiou, Katherine L. 2014. *Capsicum* spp. Project Procedure for Seed Photography. University of California-Berkeley Archaeobotany Report #77. Available at: http://archaeobotany.berkeley.edu/Research/LabReport/lab77/lab77.pdf

Chiou, Katherine L. and Christine A. Hastorf. 2015. Pachacamac, Peru *Capsicum* analysis. University of California-Berkeley Archaeobotany Report #82. Available at: http://archaeobotany.berkeley.edu/Research/LabReport/lab82/lab82.pdf

Chiou, Katherine L. and Christine A. Hastorf. 2014. A systematic approach to species-level identification of chile pepper (*Capsicum* spp.) seeds: Establishing the groundwork for tracking the domestication and movement of chile peppers through the Americas and beyond. *Economic Botany* 68(3): 316-336.

Chiou, Katherine L., Christine A. Hastorf, Duccio Bonavia, and Tom D. Dillehay. 2014. Documenting cultural selection pressure changes on chile pepper (*Capsicum baccatum* L.) seed size through time in coastal Peru (7,600 B.P.-Present). *Economic Botany* 68(2): 190-202.

Appendix 1: *Capsicum* data table (Note: table is wrapped due to length).

ID	Collection	Country of Origin	Site	Provenience	Fase	Condition	Genus	Species
ULB126-j/g-1B-Cx22	Proyecto Ychsma	Peru	Pachacamac	Not specified	Unknown	Desiccated, Excellent	Capsicum	chinense
ULB126-j-2	Proyecto Ychsma	Peru	Pachacamac	Not specified	Unknown	Desiccated, Excellent	Capsicum	baccatum

Seed Shape	Relational Length (mm)	Relational Width (mm)	RL:RW	Max Length (mm)	Perpendicular width (mm)	ML:PW	Aspect Ratio
Circular	3.8	3.51	1.082621	3.77	3.93	0.959288	1.08
Oval	4.74	4.05	1.17037	4.95	4.19	1.181384	1.2

Perimeter (mm)	Sphericity	Area (mm^2)	Diameter Max (mm)	Diameter Mean (mm)	Diameter Min (mm)	Testa texture	Beak Prominence
12.79	0.81	10.95	4.03	3.84	3.46	Smooth	2
15.37	0.71	15.48	5.01	4.61	4.06	Tight reticulation	3

Beak Angle	Attachment scar length (mm)	Attachment scar width (mm)	Attachment scar area (mm^2)	Attachment length:Relational seed length
56	1.76	0.75	0.7	0.463157895
23	1.93	0.3	0.42	0.407172996

Attachment Scar Sphericity	Testa (thin 1) mm	Testa (thin 2) mm	Testa (thin 3) mm	Testa thin avg mm	Testa thick 1 mm	Testa thick 2 mm
0.29	0.02	0.04	0.04	0.033333333	0.19	0.21
0.06	0.03	0.04	0.03	0.033333333	0.16	0.18

Testa thick 3 mm	Testa thick avg mm	Ratio (thick to thin)
0.27	0.223333333	6.7
0.15	0.163333333	4.9