

# Rice Pots or Not? Exploring Ancient Ifugao Foodways through Organic Residue Analysis and Paleoethnobotany

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**Abstract** A number of cooking pots and associated plant remains have been recovered in recent excavations at the Old Kiyangan Village in Ifugao, Philippines. These finds present the opportunity to explore the foodways of the precolonial Ifugao through organic residue and paleoethnobotanical analyses. Preliminary results of pottery residue and macrobotanical analyses are here integrated to build confidence for the identification of rice and other potential food items in their processed and/or cooked stage. By exploring the foodways of the Old Kiyangan Village using these methods, we hope to contribute to larger scale issues of Ifugao society, including past social organization and the human-environment relationship.

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**Keywords** cooking pots; foodways; Old Kiyangan; paleoethnobotany; stable isotopes

## Introduction

In June 2012, Anthropology undergraduate students from the University of Guam and graduate student volunteers from the University of the Philippines-Archaeological Studies Program (UP-ASP) participated in the excavations of the Old Kiyangan Village site (Acabado, this volume:iv, Figure 2). This site is located at the famous Rice Terraces of Ifugao Province, northern Philippines (Acabado, this volume:iii, Figure 1). Among the finds recovered were cooking pots and plant remains. These finds present the opportunity to explore the foodways of the precolonial Ifugao through analyses of organic residues from pottery and macrobotanical remains. It is possible that the Ifugao, similar to the Kalinga (Stark 1991), used separate pots to cook rice. The Old Kiyangan Village site, therefore, allows us to corroborate archaeological findings with ethnohistoric accounts.

Authors note that rice residues and other starchy sources, such as maize, are difficult to recover in experimental pottery (e.g., Reber and Evershed 2004), and this is also true for archaeological pottery. However, if organic residues can be identified in these archaeological remains, it may then be possible to identify rice and other food sources, and the findings will allow us to build confidence for the identification of rice and other potential food items in their processed and/or cooked stage.

Our study explores the foodways at the Old Kiyangan Village using methods of archaeological science to contribute

to the larger discussion concerning past social organization and human-environment relationships of the Ifugao people. Foodways are defined as the "...production and procurement, processing, cooking, presentation, and eating" (or consumption) of food (Atalay and Hastorf 2006:283), including disposal of food refuse and associated material culture (Twiss 2012). Thus, the exploration of foodways calls for the integration of findings from multiple lines of inquiry. This work underscores the value of integrating different archaeometric methods as they pertain to research problems in Southeast Asia, specifically with respect to precolonial Ifugao archaeology and foodways.

## IFUGAO ARCHAEOLOGY

The Ifugao are one of several ethnolinguistic groups in the Philippines well-documented in the ethnohistoric and anthropological literature (e.g., Acabado 2009, 2010a, b; Barton 1919, 1922, 1930, 1938, 1955; Beyer 1955; Conklin 1967, 1980; Lambrecht 1929, 1962, 1967; Maher 1973, 1978, 1984, 1985, 1989; McCay 2003; Stanyukovich 2003). The intensive investigations of the Ifugao began with Barton (1919, 1930) and Beyer (1926, 1955), both prominent figures in Philippine anthropology, at the turn of the twentieth century. Both scholars proposed a 2,000-3,000 year old origin for the Ifugao rice terraces, using observations and qualitative speculations on how long it took the Ifugao to modify the rugged topography of the area. This 'long history' (Acabado

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Table 1. Age estimations proposed for the inception of the Ifugao Rice Terraces.

AUTHOR	DATE	EVIDENCE
Barton (1919) and Beyer (1955)	2000-3000 YBP	Estimated how long it would have taken to construct the elaborate terrace systems which fill valley after valley of Ifugao country
Keesing (1962)	<300 YBP	Movements to upper elevation of Cordillera peoples were associated with the Spanish pressure
Lambrecht (1967)	<300 YBP	Used lexical and linguistic evidence by analyzing Ifugao romantic tales ( <i>hudhud</i> ); Observed short duration of terrace building and concluded a recent origin of the terraces
Maher (1973: 52-55)	205 ± 100 YBP 735 ± 105 YBP	Radiocarbon dates from a pond field and midden
Acabado (2009:811; 2010b)	Post-AD1585	Bayesian modeling of radiocarbon dates obtained from the Bocos terrace system, Banaue, Ifugao; Paleoethnobotanical information from soils recovered from the Old Kiyangan Village

2009, 2015a) has become a kind of received wisdom that finds its way into textbooks and national histories (Jocano 2001; UNESCO 1995).

On the other hand, several scholars have proposed a more recent origin of the Ifugao Rice Terraces (Table 1). Using evidence from lexical information and ethnohistoric documents, these studies suggest that the terraced landscapes of the Ifugao are the end-result of population expansion into the Cordillera highlands in response to Spanish colonization. Lowland-upland contacts, even before the Spanish arrived and established their bases in the locales, might have facilitated the movement of lowland peoples to the highlands (Keesing 1962).

The Ifugao Archaeological Project's (IAP) investigations (Acabado 2009, 2010a, 2010b; Acabado et al. 2012) have established the "short history" model (Acabado 2009) for the inception of the Ifugao terraces. By integrating archaeological, ethnohistoric, ethnographic, and landscape datasets, it argues that the terraces in the Philippine Cordilleras are not much older than 500 years old. Information described in this paper confirms this finding.

For this study, two earthenware sherds (Accession numbers CAR-2012-W<sub>1</sub>-3832 and CAR-2012-W<sub>1</sub>-3996) with charred surface residues recovered from Trench 3 of the Old Kiyangan Village site were examined. This area of the excavation was where a *bale* (house) previously stood. Macrobotanical remains were also examined in the fill of three complete earthenware vessels associated with an infant burial, and bulk sediments recovered from Trench 4.

### STABLE ISOTOPE RATIO ANALYSIS OF CHARRED SURFACE RESIDUES

*Background.* Diet can be reconstructed using stable carbon and nitrogen isotope ratios derived from consumer tissue, plant remains, and pottery food residues (Beehr and Ambrose 2007a, 2007b; DeNiro 1987; Evershed 2009). Differences in isotope ratio are due to differences in the mass of an element, and stable isotope ratios are reported using the following equation:

$$\delta(\text{‰}) = [(R_{\text{sample}}/R_{\text{standard}}) - 1] \times 1000,$$

where R = <sup>13</sup>C/<sup>12</sup>C or <sup>15</sup>N/<sup>14</sup>N

In the case of carbon (<sup>13</sup>C/<sup>12</sup>C), differences in δ<sup>13</sup>C values are principally based on differences in the photosynthetic pathway that exist in primary producers (plants). C<sub>3</sub> plants follow the Calvin-Benson cycle and include temperate shrubs, trees, leafy herbaceous plants, tubers, legumes, and cold- and shade-tolerant grasses. C<sub>4</sub> plants, by contrast, follow the Hatch-Slack cycle and include arid-adapted and tropical grasses. C<sub>4</sub> plant foods are more enriched in <sup>13</sup>C and have less negative δ<sup>13</sup>C values than C<sub>3</sub> plants (Figure 3). At present, the δ<sup>13</sup>C value of atmospheric CO<sub>2</sub> is approximately -8 ‰; however, the burning of fossil fuels due to human activities for the last 200 years has caused a depletion of approximately 1 ‰ in δ<sup>13</sup>C values of the atmosphere. For C<sub>3</sub> plants, the δ<sup>13</sup>C values range from -34 to -23 ‰ and the industrial-era average δ<sup>13</sup>C value is -26.5 ‰. For C<sub>4</sub> plants, the δ<sup>13</sup>C values range from -16 to -8 ‰ and the industrial-era average δ<sup>13</sup>C value is -12.5 ‰ (Beehr and Ambrose 2007a, 2007b; Evershed 2009; O'Leary 1981). In Southeast Asia, commonly consumed C<sub>3</sub> plants include rice and starchy tubers (DeNiro 1987); C<sub>4</sub> plants include various millet species (DeNiro 1987), Job's tears (Rumpel et al. 2006), sugarcane (DeNiro 1987), and sedges (Caton et al. 2010).

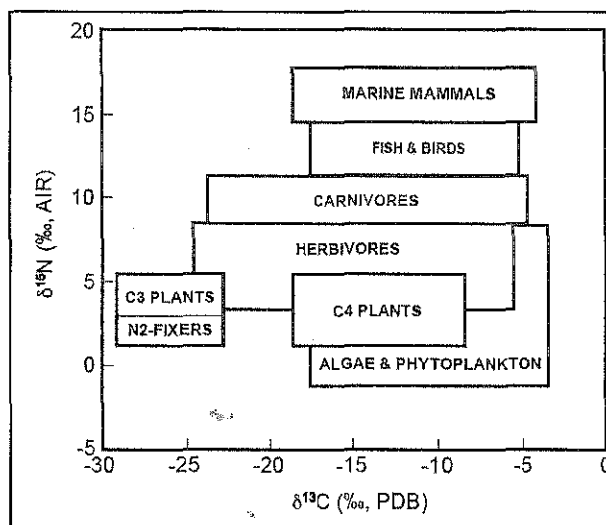


Figure 1. Isotopic diagram for carbon and nitrogen stable isotopes (adapted from Evershed 2009 and O'Connell 1996).

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In the case of nitrogen ( $^{15}\text{N}/^{14}\text{N}$ ), differences in  $\delta^{15}\text{N}$  values often reflect differences in trophic level because nitrogen is ubiquitous in protein (Beehr and Ambrose 2007a, 2007b; Evershed 2009). Primary and secondary consumers, such as animals, tend to have higher  $\delta^{15}\text{N}$  values than the primary producers, or plants (Figure 1). This is due to the stepwise increase of ~3.5 ‰ between trophic levels in the food web; thus,  $\delta^{15}\text{N}$  values help to distinguish the contributions of plants vs. animals in the diet (Ambrose 2000; DeNiro and Epstein 1981; Schoeninger and DeNiro 1984). These shifts between trophic levels are commonly used in archaeology to assess dietary preferences (Evershed 2009). However, it is difficult to assess the proportions of plants vs. animals in human diet because the latter have much more protein than the former. A few animal meats regularly included in the diet would result in large increases in  $\delta^{15}\text{N}$  values in consumer tissue (Beehr and Ambrose 2007a, 2007b). Although plants do not fractionate the N, absorbed from the soil (Garten 1993), the variation in  $\delta^{15}\text{N}$  values of plants derives principally from the variation in  $\delta^{15}\text{N}$  values of nitrates in the soil (Handley and Raven 1992). Therefore, plants that fix  $\text{N}_2$  from the soil exhibit higher  $\delta^{15}\text{N}$  values than those that fix atmospheric  $\text{N}_2$  during processes of denitrification (Shearer and Kohl 1986).

**Documentation.** The two earthenware pottery sherds examined were documented and photographed. Referring to the stratigraphic profile of Trench 3, one sherd (CAR-2012-W<sub>1</sub>-3832) was recovered from Level 11, Layer 5 (Figures 2 and 3). The second sherd (CAR-2012-W<sub>1</sub>-3996) was recovered from Level 9, Layer 4 (Figures 2 and 4). The charred interior surface residues were examined using a Zeiss Discovery.V8 Stereomicroscope and photographed. After documentation, each charred residue was scraped using a scalpel and stored in a glass scintillation vial. The sherds with no surface residue present were analyzed by cross-section analysis, their edges broken with a pair of pliers. The fresh breaks were examined using a Bausch and Lomb StereoZoom 5 microscope at 8x magnification and compared with the Wentworth Sand Size Reference Chart (Wentworth 1922) to determine the size of sand inclusions. The relative abundance of sand inclusions was documented using the percentage inclusion chart by Matthews et al. (1991). The cores were compared with the stylized cross-sections following the work of Rye (1981).

**Bulk Stable Isotope Analysis.** Sample preparation was done in the Bone Chemistry Laboratory, Department of Anthropology, University of Florida. The two charred residue samples were ground with an agate mortar and pestle. Each sample was then divided into two subsamples,

A and B. Subsample A was left untreated while subsample B was treated with 0.1 M HCl, rinsed with deionized distilled H<sub>2</sub>O to neutral (pH = 7), and oven dried at 60°C. Residue sample was then weighed and loaded into tin cups and  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$  values were obtained using a Thermo Electron Delta V Advantage Isotope Ratio Mass Spectrometer coupled with a ConFlo II interface linked to a Carlo Erba NA 1500 CNS Elemental Analyzer housed in the Stable Isotope Mass Spectrometry Laboratory, Department of Geological Sciences, University of Florida. Standards used were Vienna Pee Dee Belemnite (PDB) and atmospheric  $\text{N}_2$  (AIR) for  $\delta^{13}\text{C}$  and  $\delta^{15}\text{N}$ , respectively.

## MACROBOTANICAL ANALYSIS

The sediments collected and analyzed were recovered from three distinct features (2, 3 and 4) in Trench 4 (the three complete pots, see Figure 5). Manual flotation using 200  $\mu\text{m}$  sieve bags was utilized to recover the macrobotanical remains. The volume range of the sediment floated was between 0.25-30 L. The sediments were processed along the Ambangal River, near the excavation site. After washing, the flotation samples were air-dried for three days while the heavy fraction materials were washed using a 1 mm kitchen sieve. These samples were then air-dried and sorted at the camp site. All flotation samples were brought to the Plant and Sediment Laboratory of the UP-ASP for analysis. Samples were sieved using 1 mm and 500  $\mu\text{m}$  aperture test sieves and a low-power microscope (Nikon SMT 745T model with 0.60x-50x magnification) while isolating in each sample separate plant remains. The plant remains were sorted, identified, counted, and sorted again. Different archaeological macro-plant types were stored in labelled plastic vials.

## RESULTS AND DISCUSSION

### Charred surface residues

Both earthenware pottery sherds with charred interior surface residues were about a centimeter thick, with iron-rich inclusions, and were fired under reduced atmosphere (see Table 2). The sherd CAR-2012-W<sub>1</sub>-3996 was cooled rapidly in air, which may explain why it is softer than the other sherd, and had thicker interior soot (see Figure 6), which explains why it produced more sample for isotopic analysis. The thicknesses of both sherds are typical for cooking pots (Rice 1987).

The results of the bulk stable isotope ratio analysis of the charred residues are listed in Table 3. To our knowledge, these are the first results from the charred surface residues in pottery from the Philippines submitted for initial assessment

Table 2. Attributes of pottery sherds from Trench 3, Old Kiyangan Village Site.

CAR-2012-W <sub>1</sub>	Layer	Average Thickness (mm)	Inclusion	Size	%	Firing	Exterior Carbon deposit	Interior Carbon Deposits
3832	5	9.85	With Fe	Non-uniform	20	Reduced atm.	Soot	Thin soot
3996	4	11.5	With Fe	Non-uniform	20	Reduced atm. cooled rapidly in air	None	Thick soot

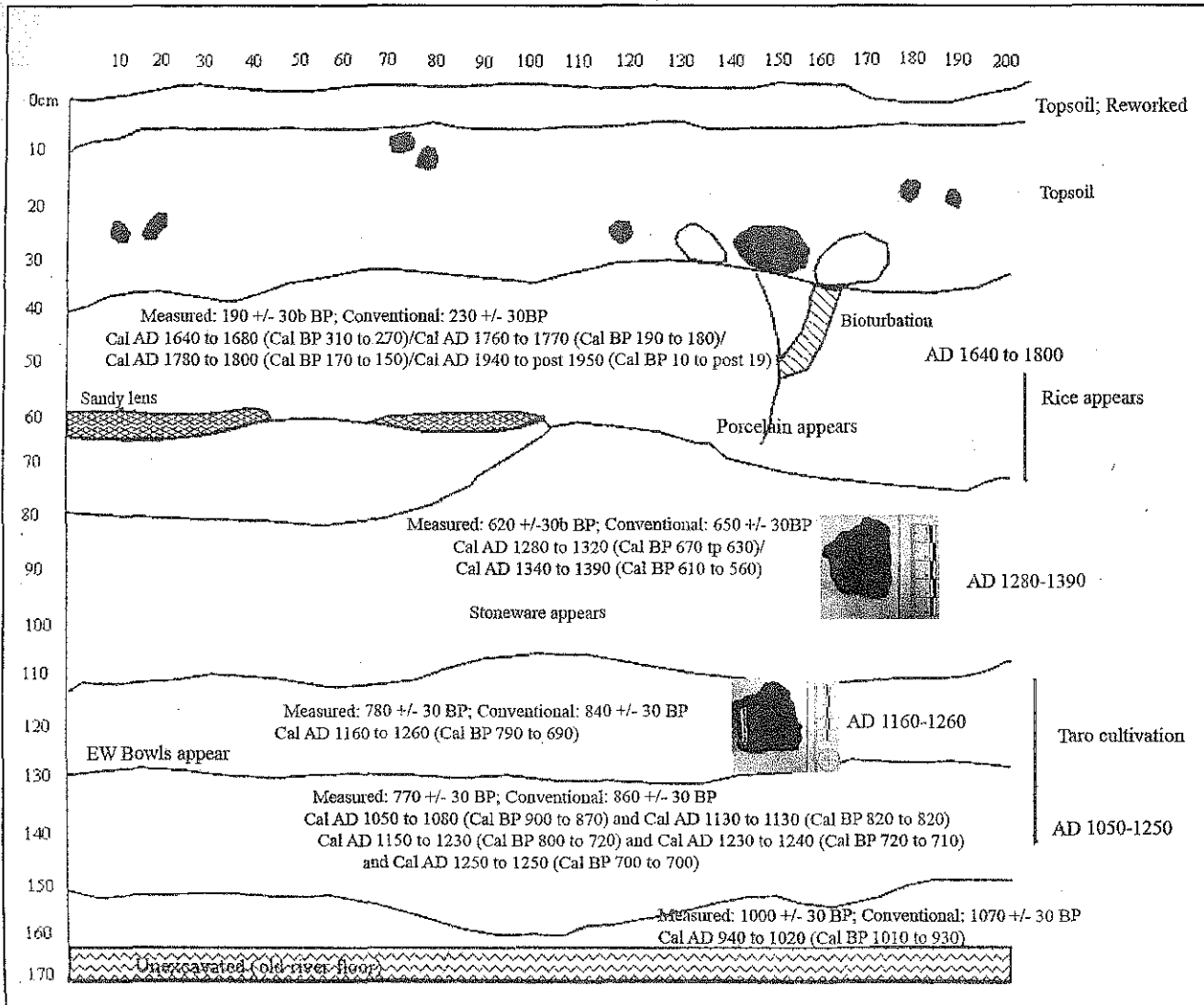


Figure 2. Trench 3 stratigraphic profile (modified after Acabado et al. 2012:18, Figure 14). The pottery sherd sample from Layer 4 is CAR-2012-W<sub>1</sub>-3996 (Level 9) and the other sample from Layer 5 is CAR-2012-W<sub>1</sub>-3832 (Level 11).



Figure 3. CAR-2012-W<sub>1</sub>-3832 from Trench 3, Level 11, Layer 5 (M. S. Eusebio, 2013).

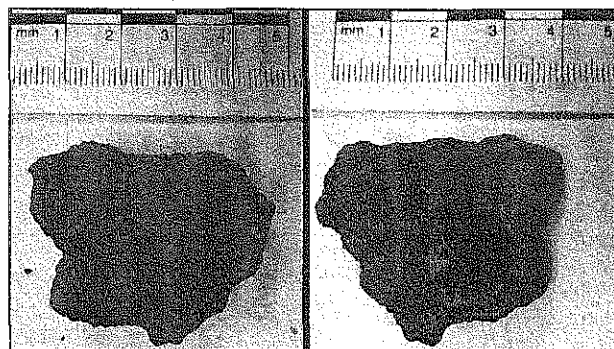


Figure 4. CAR-2012-W<sub>1</sub>-3996 from Trench 3, Level 9, Layer 4 (M. S. Eusebio, 2013).



Figure 5. Fe at the upper lower right courtesy of

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Figure 5. Feature 2 (pottery vessel at upper right corner), 3 (vessel at the upper left corner), and 4 (pottery vessel in foreground, lower right corner) in Trench 4, Old Kiyangan Village site (photo courtesy of S. B. Acabado, IAP 2012).

of food content, rather than for radiocarbon dating. Although only two sherds were analyzed, each produced different results. Both exhibit low  $\delta^{15}\text{N}$  values between 1.0 and 5.0 ‰, indicating a plant source (see Figure 3 for reference); however, the difference in  $\delta^{13}\text{C}$  values between the two samples suggest that different types of plant foods were cooked in the two pottery vessels. A  $\text{C}_3$  plant food was cooked in the vessel of sherd CAR-2012- $\text{W}_1$ -3832 and a  $\text{C}_4$  plant food was cooked in the vessel of sherd CAR-2012- $\text{W}_1$ -3996.

Sherd CAR-2012- $\text{W}_1$ -3832 supports findings from the microbotanical fossil analysis of charred residues in another portion of that sherd and associated soil samples (see Figure 7). No rice phytoliths were found among the identified phytoliths and starches, supporting other findings that, at the time of the Little Ice Age (A.D. 1300), taro and other starchy staples were cultivated in the terraces before wet-rice cultivation. The Little Ice Age was a period that would have been more arid in the lowland regions of northern Philippines. In addition, people were processing starchy crops such as tubers, fruits, and palms in the pot. Since *Colocasia esculenta* or taro was not identified in the vessel of sherd CAR-2012- $\text{W}_1$ -3832, other starchy aroids could have possibly been cooked in that pot. These could be giant taro (*Alocasia macrorrhiza*), swamp taro (*Cyrtosperma merkusii*), yam (*Amorphophallus*

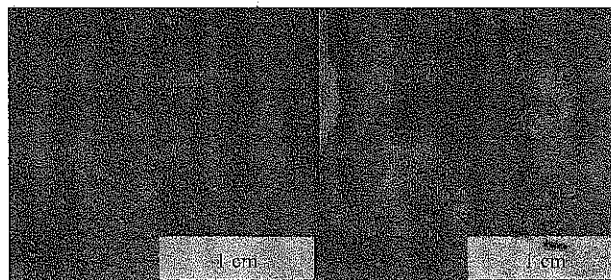


Figure 6. Interior carbon deposits (5x) of CAR-2012- $\text{W}_1$ -3832 (left) and CAR-2012- $\text{W}_1$ -3996 (right) (M. S. Eusebio, 2013).

*paeoniifolius*), and arrowroot (*Tacca leontopetaloides*), breadfruit (*Artocarpus altilis*), or a type of palm, based on the possible identifications of phytoliths from the charred residues from sherd CAR-2012- $\text{W}_1$ -3832 (Acabado et al. 2012).

In the case of sherd CAR-2012- $\text{W}_1$ -3996, the corresponding analysis of microbotanical fossils from associated sediments in Layer 4 is still underway. All  $\text{C}_4$  plant food sources in Southeast Asia, including millet [broomcorn millet (*Panicum miliaceum*) and foxtail millet (*Setaria italica*)], Job's tears (*Coix lacryma-jobi*), sugarcane (*Saccharum officinarum*), and sedges (family Cyperaceae) are possible. Millet remains have been found at a number of archaeological sites in East and Mainland Southeast Asia (Lu et al. 2009, see also Castillo and Fuller 2010). Less common are remains of Job's tears, which to date have only been recovered at archaeological sites in East Timor (Glover 1986) and Guam (Moore 2005), as well as phytoliths of sedges found in Thailand (Kealhofer 1996). Sugarcane phytoliths have been identified in sediments and from one Latte period pottery sherd from archaeological sites on Guam (Moore 2005, 2012). The proximity of Guam to the Philippines points to the possibility that sugarcane may have been cultivated alongside taro on the terraces of Ifugao before rice. It is also possible that sugarcane juice was boiled in the pot associated with sherd CAR-2012- $\text{W}_1$ -3996 to make a crude, moist sugar (*panoche*) or a thick syrup (*panocha*) (cf. Moore 2012), as shown by its thicker soot.

#### Macrobotanical remains

Macrobotanical analysis results suggest that most seeds recovered in the sediments from the three pots were from weeds associated with farming (Table 4). There are charred

Table 3. Bulk carbon and nitrogen isotopic signatures of charred interior surface residues of pottery sherds recovered from Trench 3, Old Kiyangan Village Site.

CAR-2012- $\text{W}_1$	$\delta^{15}\text{N}$ (‰ AIR)	$\delta^{13}\text{C}$ (‰ PDB)	wt %N	wt %C	Remarks
3832 – A (untreated)	2.52	-23.55	0.90	20.39	$\text{C}_3$ plant
3832 – B (treated)	1.15	-23.79	0.93	21.02	
3996 – A	2.72	-11.59	0.61	39.82	$\text{C}_4$ plant
3996 – B	2.03	-11.38	0.51	39.93	
3996 – A (rerun)	3.82	-11.65			
3996 – B (rerun)	3.14	-11.52			

Figure 7. Phytolith percentage and pollen/starch diagram from Old Kiyangan Village, Ifugao, Philippines (+ = found after count, ++ = present in small amounts) (adapted from Acabado et al. 2012:20).

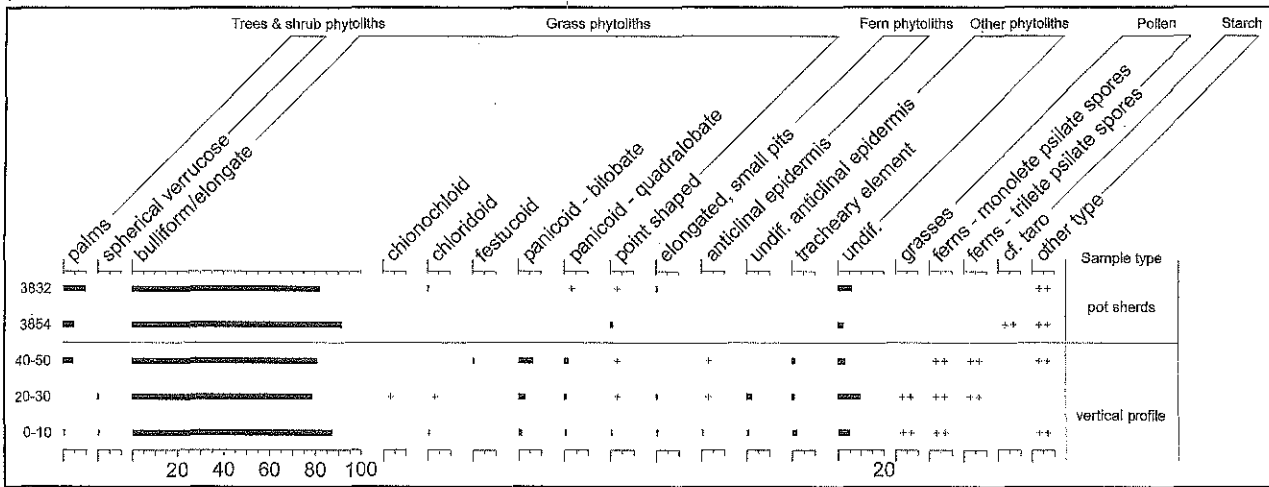


Table 4. Macrobotanical remains from Trench 4, Old Kiyangan Village Site.

TRENCH	UNIT	FEATURE	VOLUME (L)	TRANSFORMED	UNTRANSFORMED	WOOD	PARENCHYMA	NON-BOTANICAL	NOTES
4		4	30	27 whole charred prob. <i>Spilanthes</i> Jacq., 11 fragmented charred prob. <i>Spilanthes</i> Jacq.	5 roundish (whole); 2 roundish fragments; 1 flattish (light yellowish); 7 fragments of prob. seed coat; 2 spheroid; 2 roundish (black); 1 <i>Oryza</i> sp.	present		2 microshells	
4		3	0.25	1 charred <i>Hypericum</i> prob. <i>japonicum</i> ; 1 prob. charred Cyperaceae	1 <i>Hypericum</i> prob. <i>japonicum</i> ; 1 seed coat (UnID); 1 <i>Boehmeria</i> prob. <i>platanifolia</i>	present	present	1 bone fragment	Soil inside pot
4		2	3.25	2 charred prob. <i>Spilanthes</i> Jacq. (whole); 1 charred prob. <i>Portulaca oleraceae</i>	16 whole seeds; 2 fragmented seed coat of rounded seeds; 2 angular; 3 Cyperaceae seed coat	present			Fill inside pot
4		2	9.5	48 charred prob. <i>Spilanthes</i> Jacq. (whole); 8 fragmented prob. <i>Spilanthes</i> Jacq.	1 unID seed coat; 1 spheroid; 7 Poaceae; <i>Spilanthes</i> Jacq.; 7 roundish; 6 prob. Bidens; 1 flattish; 1 spheroid (white); 1 spheroid (gray); 3 Digitaria; 2 flattish (white); 4 <i>Boehmeria platanifolia</i> ; 5 flattish	present		insect parts; bone fragments	
4		3	9.5	89 whole charred prob. <i>Spilanthes</i> Jacq.; 47 fragmented charred prob. <i>Spilanthes</i> Jacq.	2 Paspalum; 4 roundish (orange); 33 whole flattish (white); 3 fragmented flattish (white); 1 Poaceae; 1 Convulaceae	present		fragments of human bones (neonate); insect parts	

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seeds of probably *Spilanthes* Jacq. in the light fractions from the pots in Features 2 and 4, and charred seeds of possibly *Portulaca oleraceae* in Feature 2. In Unit 3, charred seed of Cyperaceae and charred *Hypericum* probably *japonicum* were identified. In literature, the seeds of *S. urens* Jacq. and *H. japonicum* have medicinal uses and benefits (Burkill 1966; Wu et al. 1990; Rajalakshmi and Jose 2011). Thus, these could have possibly been used as medicine in the Old Kiyangan Village. No charred cereal and/or *Oryza* sp. were recovered among the macrobotanical remains, although there were several unidentified charred wood and parenchymatous plant tissue fragments.

## CONCLUSIONS AND RECOMMENDATIONS

Preliminary findings from charred organic residue analysis and macrobotanical analysis suggest there is no evidence for rice cultivation, processing, and cooking at the Old Kiyangan Village prior to the Little Ice Age (ca. A.D. 1300) and Spanish colonization (ca. A.D. 1565) of the Philippines. Thus, the pottery vessels analyzed here were not rice pots. Instead, the findings reflect the cultivation, processing, and cooking of other starchy sources, such as taro, yam, breadfruit, arrowfruit, palms, and an unidentified  $C_4$  plant.

Based on these results and analyses of other materials excavated from the Old Kiyangan Village (Acabado et al. 2012; Ledesma et al. 2013, this volume; Moore et al. 2013), precolonial Ifugao utilized a broad range of food resources. In addition to rearing and management of pig, chicken, and water buffalo (Ledesma et al. 2013, this volume), the people of Old Kiyangan Village cultivated tubers, other starchy staples (Moore et al. 2013), and  $C_4$  plant(s), which may have included millet, Job's tears, or sugarcane. Major protein sources were likely obtained by hunting deer and smaller terrestrial animals in addition to freshwater fishing (Ledesma et al. 2013). As shown by the low  $\delta^{15}N$  values from charred surface residues of two pottery sherds, plant foods were most likely boiled in cooking pots.

Food was likely served on tradeware and previously undocumented earthenware bowls from the Philippines. The villagers had jars for storing water (Acabado et al. 2012). Aside from access to starchy staples and fruits (Moore et al. 2013), the precolonial Ifugao mainly ate more wild animals (deer) than domesticated animals (Ledesma et al. 2013, this volume). Domesticated pigs may have been utilized for ritual purposes, similar to the practices observed in modern-day Ifugao (Ledesma et al. 2013). They disposed their refuse possibly in house middens (Acabado et al. 2012), but kept the skulls of domesticated animals for display (Ledesma et al. 2013). They modified their environment through clearing for the cultivation of starchy food resources (Moore et al. 2013) but still relied on neighboring forest ecotones to obtain animal protein by means of hunting (Ledesma et al. 2013, this volume). These foodway patterns suggest that they maintained an intimate relationship with their environment, which has important implications on inferring past social organization.

This preliminary work provides new insight into the archaeology of the Old Kiyangan Village. It suggests the possible use of  $C_4$  plants prior to Spanish colonization and the possibility that particular plant food sources were prepared in earthenware cooking vessels. Further isotopic sampling of pottery with charred interior surface residues is warranted to corroborate findings with analyses of recovered macro- and microbotanical remains. The analysis of diagnostic features of the pottery could, for example, clarify different functional roles associated with different pots. Appropriate procedures for the extraction, identification and analysis of organic molecules from surface and absorbed pottery residues will facilitate our ability to specify the food source prepared in different types of pottery vessels. Procedures for archaeological lipids may not be appropriate if food sources were principally composed of  $C_3$  and  $C_4$  carbohydrates. Colonial period pottery vessels should also be included in future analyses, where former contents can be correlated with change in pottery form and function as well as changes in foodway practices.

Further analyses of the charred parenchymatous plant tissues from Trench 3 through scanning electron microscopy (SEM) will allow us to determine the type of tuber, as well as wood identification of charcoal samples from Features 2 and 4 in Trench 3. The collection of botanical and faunal remains must be maximized, where all trenches or excavation areas and features (not only mortuary pots) are represented. These findings from the analyses of material culture and macrobotanical remains must be integrated to accurately inform past foodway practices of the people of Old Kiyangan Village.

## Acknowledgments

*This paper was presented in the session on "Early Farming Communities in East and Southeast Asia" at the 78th Annual Meeting of the Society for American Archaeology, April 3-7, 2013 in Honolulu, Hawai'i. The materials analyzed were recovered during the 2012 Field School of the Ifugao Archaeological Project, which included individuals from the Department of Anthropology (University of Guam), Save the Ifugao Terraces Movement (SITMo), National Museum of the Philippines, and the UP-ASP. At UP-ASP, Jasminda R. Ceron processed and analyzed the macrobotanical remains. At the University of Florida, surface residue samples were processed in the Bone Chemistry Laboratory, Department of Anthropology by Michelle S. Eusebio. Dr. Jason Curtis conducted the mass spectrometry in the Stable Isotope Mass Spectrometry Laboratory, Department of Geological Sciences. Dr. Neill Wallis granted access to the facilities of the Florida Museum of Natural History for the cross-section analysis of the pottery sherds. Lastly, the Department of Anthropology and Office of Research at the University of Florida provided conference travel support to Michelle S. Eusebio.*

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