Indigenous technologies and the production of early colonial ceramics in Dominican Republic

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Abstract

This study sought to investigate the extent and processes through which indigenous technologies were passed on in the production of indigenous pottery in the Greater Antilles, the Caribbean, during the early colonial period in the late 15th and early 16th centuries AD. We examined a selection of black wares and red wares recovered from an early colonial archaeological site of Pueblo Viejo de Cotuí, Dominican Republic. We devised an integrated approach, which combined anthropological theory of cultural transmission and archaeological science. Thin-section petrography was used to characterise five main aspects of the production of the ceramic assemblage, including raw materials selection, paste preparation, forming, surface finish, and firing methods. We then compared the results with the analyses we had previously conducted on the production of pre-colonial Meillacoid and Chicoid ceramics, which allowed us to delineate the extent and processes of technology transmission. Our findings reveal that indigenous technologies were neither fully replicated nor discontinued in the production of black wares and red wares at Cotuí during the early colonial period. Instead, the producers of both black wares and red wares continued to use certain aspects of indigenous technologies, but each with varying extents. The black wares largely followed the local indigenous ways as expressed in the selection of local raw materials, low level of standardisation in paste preparation, the use of coiling and low firing temperatures. As for the red wares, it is certain that their production continued with the use of local raw materials and low firing temperatures, whereas it is possible that the use of grog temper and red slips also represents the transmission of indigenous technologies that were linked to roots other than the Meillac and Chican ceramics.

Highlights

- We examined a selection of early colonial black wares and red wares from Cotuí.
- Petrography and cultural transmission theory was used to chart technology transfer.
- There was some continuation of indigenous technologies but with modification.
- Black wares production showed stronger local indigenous influences than red wares.

Keywords: Indigenous ceramics, production, Caribbean archaeology, colonial encounter, thin-section petrography, cultural transmission

I. Introduction

The arrival of Christopher Columbus and the Spaniards in the Greater Antilles in the late 15th century AD had a fundamental impact not only in shaping the historical developments and socio-political and cultural landscapes of the region, but also on the production and representation of material culture (Hofman et al., in press; Ulloa Hung, 2014). Acculturation has long been argued to be the primary force dictating the production of early colonial material culture. In the acculturation model, the dominant colonising 'donor' culture is said to have transformed the more passive indigenous 'recipient' culture of the host community with assimilation being the main mechanism behind such transformation (Quimby and Spoehr, 1951; Stein, 2005: 16). The depiction of such unidirectional interaction between indigenous populations and European colonisers was largely derived from written sources such as imperial records and travellers' diaries, which are often biased in narration.

This conventional interpretation has become increasingly challenged by scholars, following the discovery of more archaeological sites dating to the early colonial period, as well as the re-examination of material evidence (cf. Deagan, 1987, 1988, 1995, 1996; Deagan and Cruxent, 2002; Ewen, 2001; Garćia Arévalo, 1978; Vander Veen, 2006; Valcárcel Rojas et al., 2011). All these called for a more balanced representation with specific emphasis on the roles played by indigenous actors in shaping early colonial material culture. Since then, scholars have advocated the transculturation model, which highlights the bidirectional or multidirectional processes that were involved in the formation of diasporic cultures with entirely new and composite identities (Cusick, 1998; Deagan, 1998, 2004; Hofman and van Duijvenbode, 2011; Lightfoot, 1995; Valcárcel Rojas et al., 2013).

Pottery is often cited as evidence that reflects the occurrence of the process and outcome of transculturation between indigenous populations and European colonisers. Such conclusion was largely drawn from the stylistic analysis of early colonial ceramic assemblages (cf. Deagan, 2002a, 2002b; Domínguez, 1980; Garćia Arévalo, 1991; Ortega and Fondeur, 1978; Ortega et al., 2004; Smith, 1995; Woodward, 2006), as well as from the parallel examples of the technological studies of colonial ceramics from the Lesser Antilles (cf. Hofman and Bright, 2004) and Central America (cf. Hernández Sánchez, 2011; Iñañez et al., 2010; Liebmann, 2013; Rodríguez-Alegría et al., 2003, 2013). Thus, it is still not very clear which aspects of and how indigenous technologies, in this case those related to pottery manufacture, were passed on during the formative years of the colonial encounters in the Greater Antilles. Indigenous technologies, here, refer to the pottery manufacturing technologies used by pre-colonial producers in the Greater Antilles before the arrival of the Spaniards.

Against this background, this study sought to explore the extent and processes through which indigenous technologies were transmitted in the context of colonial encounters in the Greater Antilles as reflected in indigenous ceramic production. The early colonial indigenous ceramics recovered from the archaeological site of Pueblo Viejo de Cotuí, Dominican Republic (Olsen et al., 2011), are ideally suited to address our research objective because it was one of the first colonial conclaves that were established by Europeans in the Greater Antilles, and indeed in the Caribbean. We have devised an integrated approach, one that combines anthropological theory of cultural transmission and archaeological science, to examine the ceramic assemblage. Cultural transmission theory (CT) provides the framework enabling us to determine the process through which indigenous technologies were transmitted. Thin-section petrography was used to characterise the compositional and technological traits of the assemblage, which were useful in identifying the technological choices involved in the production of the early colonial indigenous ceramics. The results were then compared with the analysis that we have previously conducted on the pre-colonial ceramic assemblages from Dominican Republic (Ting et al., 2016), allowing us to highlight which aspects of early colonial indigenous ceramic production continued or deviated from its pre-colonial counterparts.

II. Towards the cultural transmission of indigenous technologies

Cultural transmission studies are concerned with the movement of knowledge, ideas, skills, practices, norms and values between individuals or groups via non-genetic mechanisms such as individual experimentation and social learning across the socio-cultural landscapes (Eerkens and Lipo, 2007 for overview of the cultural transmission theory; see also Cohen, 2010: S194; Ellen and Fischer, 2013: 2; Mesoudi, 2013: 131 for definition). In archaeology, such studies have often focused on tracing the evolution of individual traits of material culture over time, which serve as proxies to test hypotheses about the modes of knowledge transmission (e.g. apprenticeship contexts) and any broader social constraints (e.g. prestige) that may affect which cultural or technological traits are transmitted to the next generation. By generating specific and testable hypotheses to measure the degree of similarity of criteria such as the morphological and technological features of artefacts, cultural transmission theory has proven to be a useful framework to explain the variation and relatedness in artefact (Eerkens and Lipo, 2005; Roux, 2008: 82; Schiffer and Skibo, 1997; Stark et al., 2008: 1). Cultural transmission theory has informed previous studies on the change of technologies in the production of material culture in the context of colonial encounters in the Americas. Among the notable examples are the production of metal artefacts from the site of El Chorro de Maíta, Cuba (Martinón-Torres et al., 2012), the mining technology at the site of Pueblo of Paa-ko, New Mexico (Thomas, 2007), and food procurement, preparation and consumption in Zuni Pueblo (Mills, 2008).

In this study, we wanted to approach cultural transmission by establishing the similarities and differences between the manufacturing technologies of early colonial indigenous and pre-colonial ceramics. The cultural traits we used to assess the degree of similarity were five main aspects of pottery production – namely raw materials selection, paste preparation, forming, surface finish, and firing methods (Hofman and Bright, 2004; Roux, 2011) – all of which were characterised by using petrographic analysis. The resultant patterns were used to test hypotheses formulated to determine the possible processes through which indigenous technologies were transferred. Noteworthy is that the hypotheses are not mutually exclusive and it is possible that more than one hypothesis may at the same time explain the transmission of technological knowledge in making pottery during the early colonial period. The hypotheses are described as follows:

- Hypothesis 1: Early colonial pottery making was a continuation of pre-colonial tradition (Henrich, 2001: 997-998; Tehrani and Collard, 2013: 149; Zent, 2013: 215-216). In this case, we expect that the five aspects of early colonial pottery production were exactly the same as their pre-colonial counterparts.
- Hypothesis 2: There was some continuity in technological knowledge from before. Depending on which aspects of production that had changed and the extent of change, we suggest two possible implications for the partial continuation of the use of indigenous technologies. It may represent modification of local indigenous technologies, or hybridisation with other indigenous influence and perhaps even with incoming European technologies (Deagan 2013; van Dommelen, 2005: 117). In this

case, petrographic data would have shown that only certain aspects of early colonial pottery production display similar traits as their pre-colonial counterparts.

- Hypothesis 3: Early colonial pottery making discontinued from the pre-colonial tradition and thus represented the occurrence of innovation (O'Brien and Bentley, 2011; Schiffer, 2010; Schiffer and Skibo, 1987). Innovation in technologies could be due to intrinsic factors (e.g. active decisions on the part of the potters) or external ones (e.g. coercion by Europeans). Such drastic change would suggest that the producers derive from a different line of knowledge transmission, i.e. pottery from a different tradition of learning, whether they were Europeans or indigenous. Either way, a separate study on contemporaneous examples of European pottery manufacturing techniques in the Caribbean is warranted for comparative purposes. In this case, the petrographic data reveal that the five aspects of early colonial pottery production were entirely different from their pre-colonial counterparts.

We acknowledge that there are limitations in our power to test these hypotheses. Firstly, rather than tracking the diachronic development of indigenous technologies within one group or assemblage, our analysis was based on three different assemblages in which the early colonial indigenous ceramics from Cotuí was compared with pre-colonial ceramic assemblages from two other sites. Our justification of including pre-colonial assemblages from other sites was due to the lack of recovery of ceramics dating to the pre-colonial period from the colonial context of the mining camp at Cotuí, even though pre-colonial ceramics were recovered in the nearby cave sites. Secondly, we are not able to address aspects such as the rate and direction (e.g. horizontal, vertical and oblique) of technology transfer in our hypotheses at this stage, owing to the small sample size of early colonial indigenous ceramics included in this study.

III. Background

III.1. Early colonial indigenous ceramics

Two types of early colonial indigenous ceramics, namely the black wares and red wares, are the focus of this study. Stylistic analysis of the black wares and red wares by Ulloa Hung (2014) revealed that these ceramics retained elements of indigenous influence. The black wares are characterised by a globular body, rounded bottom, closed mouth, and straight or slightly outflaring rim with its diameter measuring almost twice as its height (Fig. 1a). The vessel walls tend to be thick and convex, with their exterior surface being smoothed over but with no decoration. Some vessels even have handles, mostly in the shape of a knob. Relic coils can be seen in the interior surface of some vessels, suggesting that coiling was the primary forming method. The black wares are further characterised by their very dark grey paste colour (10YR 3/1) throughout with abundant inclusions that are visible to the naked eye. These vessels are argued to have been used for preparing or cooking food, as evident in the deposition of thick layers of soot on their exterior surface and the starch granules on their interior surface (Pagán Jiménez, 2012).

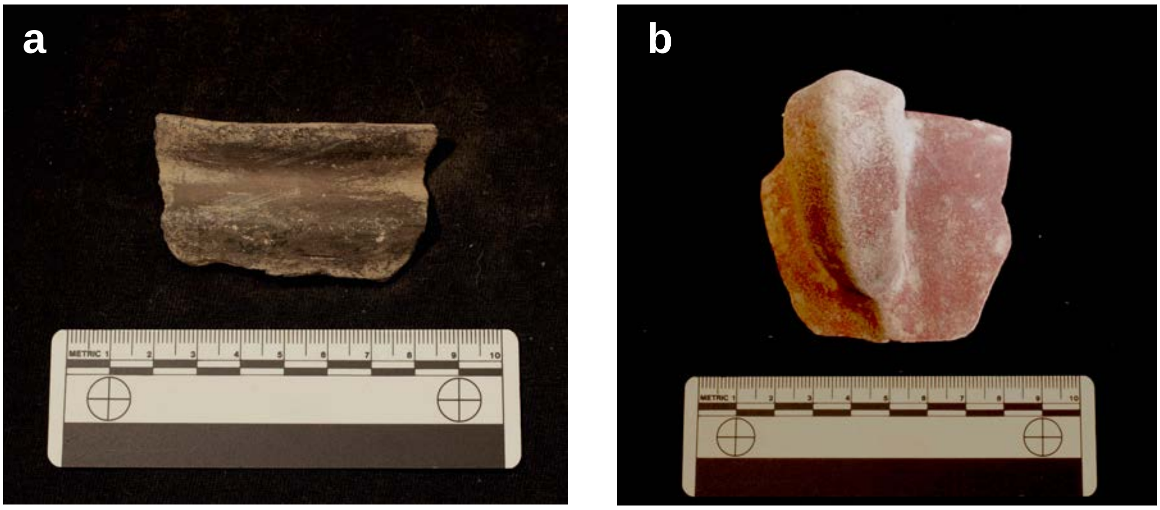


Figure 1. Early colonial indigenous ceramics: (a) black ware, and (b) red ware. Photography by Ben Hull.

The red wares also have a globular body and rounded bottom, but they are characterised by a narrow mouth, angular contours and straight or everted rim with its diameter less than half of its height (Fig. 1b). The vessel walls appear to be thinner than the black wares, with their exterior surface smoothed and covered with a thin layer of ‘red’ slip (5YR 5/8 yellowish red). Some vessels have undecorated D-shaped handles. The red wares are distinguishable for their pink (7.5YR 7/3) paste colour, and in some cases are characterised by the presence of rounded brownish red inclusions. There is no macroscopic evidence indicating the forming method of the vessel body as no relic coil can be observed on the interior surface. Also, there is no evidence showing that the red wares were subjected to intense burning, which suggests that they might have functioned as serving wares rather than being used for food preparation and cooking. Overall, both black wares and red wares are described to have a standardised appearance, displaying elements of indigenous influence, but they are argued to be a simplified version of their pre-colonial counterparts as represented by Meillacoid and Chicoid ceramics.

III.2. Archaeological and historical context

The black wares and red wares were recovered from Structure 11 of Pueblo Viejo de Cotuí (refer to as 'Cotuí' hereafter). Located in central Dominican Republic, Cotuí is the first and one of the largest gold mines in the Americas (Fig. 2). Owing to its significance, extensive excavations and research have been carried out on Cotuí by various institutions in the past decades. The latest expedition was jointly conducted by Museo del Hombre Dominicano and Oficina de Patrimonio Monumental de la República Dominicana on the premises of the mining concession of Pueblo Viejo Dominicana Coporation (Barrick Gold), yielding the early colonial indigenous ceramics included in this study.

Various historical sources recorded that Cotuí was officially founded by the Spaniards during the governance of the Jerónimos Friars that arrived in Hispaniola by the end of AD 1516 (Las Casas, 1988), even though the initial mining expedition was ordered by Nicolas de Ovando, the governor of the island, as early as in AD 1505 (Moya Pons, 1979). This colonial enclave was set up with the primary purpose of ensuring sufficient supply of labour to exploit the gold mines in the region. Recent re-interpretation of historical documents by Palm (2002) served to shed new light on the demography of the labourers working in the mines, which are believed to have reached a thousand people with almost half of them being the African slaves and Indians. In addition to these African slaves and Indians, the labourers consisted of Spaniards, as well as some twenty German miners that are believed to have arrived at Cotuí in AD 1529. The gold extracted from Cotuí is said to have sent to La Concepción de La Vega Real, where the foundries were shipped to Spain, implying the existence of exchange activities between the communities at Cotuí and La Concepción. Such exchange, coupled with the possible interactions among the labourers, is argued to have created a social dynamic that was unique to, and characteristic of, the mining conclave at Cotuí.

The settlements at Cotuí were found to be situated on an elevated area, and they consisted of the colonial structures, including a chapel or a small church, and a mining camp. These structures were surrounded by several indigenous settlements, as well as caves and rock shelters with petroglyphs and pictographs in the adjacent area (Jiménez Lambertus, 1984;

Olsen and Coste, 2008; Pagán Perdomo, 1979). Structure 11 was located in the outer areas of the colonial structures, specifically in the northeastern area that was considered as a mining camp. Traces of wooden posts were found in Structure 11, which corresponded to a perishable structure with a rectangular shape covering an area of 16m^2 (Olsen Bogaert et al., 2011). The black wares and red wares were found in association with majolica and other European ceramics dating to the 15th and 16th centuries AD, as well as a type of non-European indigenous ceramic with red paste that is said to have been produced specifically by indigenous pottery producers under the supervision of Europeans in the colonial enclave at La Concepión (Ortega and Fondeur, 1978). These ceramics were recovered in association with furnace remains, charcoal, a compacted layer of dark brown soil, and remains of chicken and cattle bones; all of which point to the domestic nature of Structure 11.

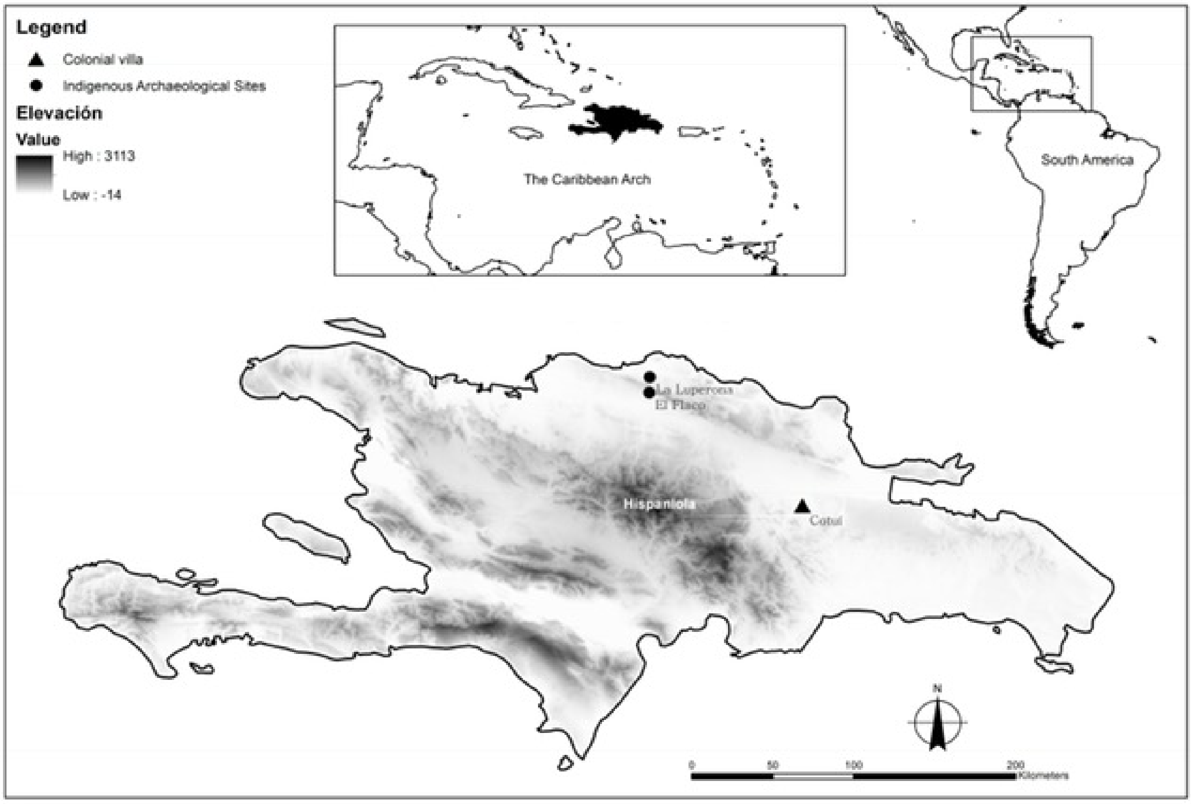


Figure 2. Map of Hispaniola showing the location of the early colonial site of Cotuí, and pre-colonial sites of El Flaco and La Luperona in Dominican Republic. Map by Eduardo Herrera Malatesta.

III.3. Geological setting

The Dominican Republic occupies the eastern half of the island of Hispaniola, which is underlain by several tectonic terranes, each with its own geologic formations, structures and lithologies, resulting in the highly complex nature of the geology of the region (Draper et al., 1994; Mann et al., 1991). The Cibao Valley – where the site of Cotuí is located at – itself is underlain by three terranes, namely the Altamira, Seibo and Tortue-Amina-Malmon terrane. The northeastern part of the valley is underlain by the Altamira terrane. The northern part is covered with alluvium, lake and fluviatile sediments, principally clay with sand and gravel, as well as a thin veneer of limestone reef, whereas the eastern part is characterised by the presence of biomicritic limestone interbedded with minor amount of volcaniclastic silt- and mudstone of the Los Hidalgos Formation. The southern part of the valley is underlain by the Seibo terrane. It consists of metavolcanites of the Los Ranchos Formation, including pillow lava and regular basalt, dacite, keratophyre, rhyolith, andesite and volcanic breccia, with outcrops of tonalite and hornblende. It is the weathered deposits of the hydrothermally altered shale of the lower Los Ranchos Formation that is responsible for the host of rich gold deposits at Cotuí (Draper et al., 1994: 132). The western part of the valley is underlain by the Tortue-Amina-Malmon terrane. It consists of a discontinuous outcrop of mainly metamorphic rocks such as quartzite, metaconglomerate, schist with graphite, and serpentinised peridotite.

IV. Method

Thin-section petrography is the ideal analytical method (see Freestone, 1995; Whitbread, 1995 for overview of the method) to examine the early colonial indigenous ceramic assemblage from Cotuí. Not only has it made the data generated by this study comparable with the previous study we have conducted on the pre-colonial ceramics, it also permits a fine-grained reconstruction of every aspect of ceramic production from raw materials selection to paste preparation, forming and firing methods. Firstly, it identifies the type of aplastic inclusions that exist in the samples, indicating the types of raw materials used. With reference to local geological data, it has also made possible the determination of the potential provenance of the raw materials used in making indigenous ceramics; thus shedding light of the raw materials procurement strategy. This is of particular importance in this case as the identification of grog temper and clay mixing in some samples has the possible effect of blurring the signature of their bulk chemical composition. Also, the overall abundance, size, sorting, and shape of the aplastic inclusions can reveal information on how the ceramic paste was prepared. For instance, the presence of angular aplastic inclusions of homogenous grain size suggests that the aplastic inclusions might have been added as temper and that the ceramic paste was prepared with a degree of standardisation.

In addition, the orientation of aplastic inclusions and voids of the samples is indicative of the forming method (Quinn, 2013). The aplastic inclusions and elongated voids are expected to display preferred orientation, i.e. parallel to the margin of the thin section sample, if the vessel was wheel thrown. Furthermore, the optical activity of the clay matrix is reflective of whether the vessel was fired at high or low temperatures (Whitbread, 1995). If the clay matrix gleams upon rotating the stage of microscope in crossed polarisation, the clay matrix is described to have displayed high optical activity, suggesting that the vessel was fired at low temperatures, and vice versa. The optical activity of the clay matrix, coupled with the macroscopic assessment of firing atmospheres, is able to tell us about the firing condition and method. Petrographic analysis was conducted on 14 samples, including nine black wares and four red wares. The thin section samples were prepared and analysed at the Centre for Archaeological Science of KU Leuven.

V. Results

Petrographic data reveal the presence of three petrofabric groups, namely the Quartz Group, Grog-tempered Group, and Amphibolite-quartzite Group. Noteworthy is the petrographic data described below is only semi-quantitative, especially regarding the relative abundance of inclusions, in which *abundant* accounts for approximately 50-70% of total amount of inclusions as seen in each sample, *common* for 30-50%, *few* for 15-30%, and *rare* for less than 15%. Estimation of the relative abundance of inclusions was done with reference to the percentage charts developed by Matthew and colleagues (1991).

V.1. Quartz Group (N=2)

Sample no.: PV70, PV78

Both samples in this group are noticeable for their fine-grained paste, with abundant quartz inclusions measuring between 0.1mm and 0.8mm in grain size, and a mode size of 0.2mm (Fig. 3a and b). The quartz inclusions are found in association with common quartzite and chert fragments, and few Fe-rich clay nodules and pellets. These inclusions are as fine-grained as the quartz inclusions, ranging from 0.1mm to 0.8mm in grain size, with a mode size of 0.1mm. Such fineness might have been obtained by removing the coarse-grained inclusions in preparing the paste, which makes the determination of the potential provenance of these vessels difficult. Yet, the presence of quartzite in these samples is geologically linked to the western part of the Cibao Valley, which is underlain by the Tortue-Amina-Malmon terrane. This finding suggests that the vessels were made by using the raw materials that were procured from the areas adjacent to Cotuí and thus establishes a local provenance for these vessels. In terms of technological traits, no preferred orientation can be observed in the alignment of inclusions and voids. The homogenous bright paste colour throughout indicates that the vessels were fired in a well-oxidised atmosphere, whereas the high optical activity of the clay matrix points to low firing temperatures. A thin layer of dark red slip was identified along the exterior margin of PV70 (Fig. 3c). This petrofabric is only associated with the red wares.

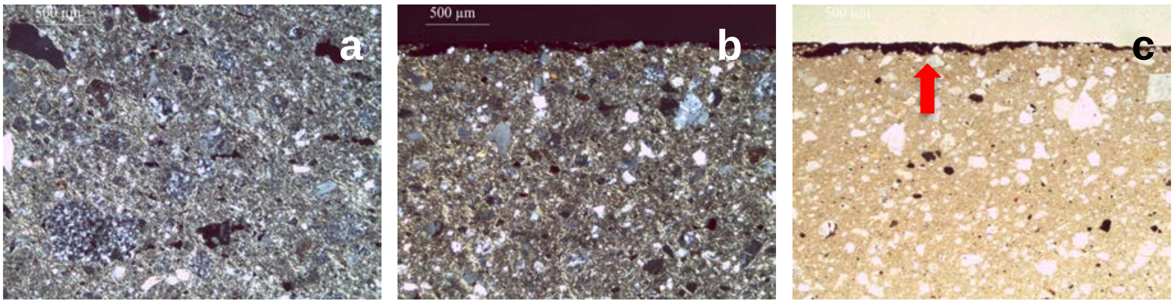


Figure 3. Photomicrographs showing samples of the Quartz Group: (a) PV78 in XP, (b) PV70 in XP, and (c) the presence of a thin layer of dark red slip along the exterior margin (indicated by arrow) of PV70 in PPL. All photomicrographs are taken in x50 magnification.

V.2. Grog-tempered Group (N=3)

Sample no.: PV66, PV67, PV80

Grog (crushed pottery fragments), which is recognisable for its dark reddish brown colour, rounded shape, and sharp grain boundary, was added in abundance as temper to the samples of this group (Fig. 4a to c). In most cases, the grog temper consists of fine-grained quartz, plagioclase feldspar, and amphibole inclusions, which measure between 0.2mm and 1.5mm in size, with a mode size of 0.5mm. In addition to grog temper, inclusions such as quartzite, amphibolite, quartz, amphibole, and plagioclase feldspar are present, with their occurrence varying from common to few depending on the sample. Again, the presence of quartzite and amphibolite in these samples are consistent with the geology of the western part of the Cibao Valley, which is likely the origin of the raw materials used in making the vessels.

Turning to the technological traits, the inclusions and voids of all samples do not display preferred orientation. Yet, the inclusions of PV66 and PV67 are coarser-grained and more sparsely spaced than those of PV80, which are slightly finer-grained and more closely packed. Apart from the difference in their texture, PV66 and PV67 also display characteristic orangey brown paste, as opposed to the darker brown paste colour of PV80. Nonetheless, no dark firing core can be observed in any of the samples, suggesting that the vessels were fired in a well-oxidised atmosphere, whereas the high optical activity of the clay matrix points to low firing temperatures. Although no dark firing core can be found, the clay matrices of PV66 and PV67, in particular, are far from homogeneous, as is evident from the presence of stripes of pale brown clay, which might be indicative of clay mixing. A thin layer of dark reddish brown slip, which is characterised by the presence of fine-grained quartz, quartzite, and amphibole inclusions, can be observed along the exterior margin of PV66. This petrofabric is also only associated with the red wares.

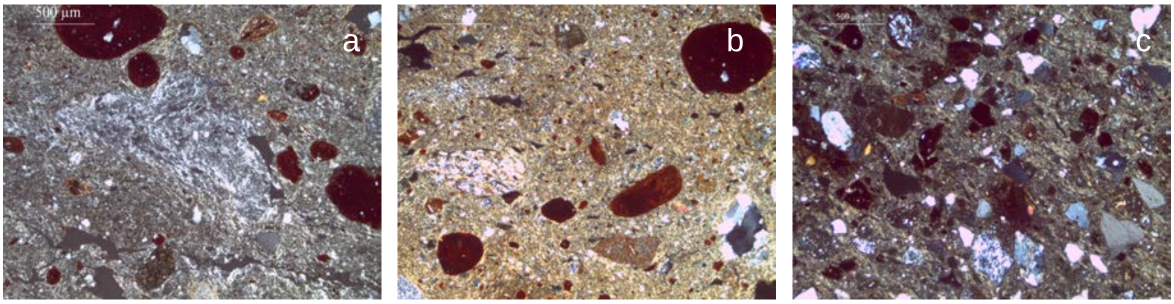


Figure 4. Photomicrographs showing samples of the Grog-tempered Group: (a) possible clay mixing of PV66, (b) PV67, and (c) PV80. All photomicrographs are taken in XP at x50 magnification.

V.3. Amphibolite-Quartzite Group (N=6)

Sample no.: PV68, PV69, PV71, PV74, PV75, PV79

All samples in this group have similar mineralogy, consisting of inclusions of amphibolite, quartzite, dolerite, quartz, amphibole, plagioclase feldspar, and serpentinite. However, the relative proportion of these mineralogical constituents, as well as their size, shape, and distribution, vary from sample to sample (Fig. 5a to f); thus making the division of the samples into further subgroups difficult. The inclusions measure a wide range of grain sizes from 0.1mm to 2.0, with no apparent mode size. The inclusions of PV68 are the finest-gained in this group, measuring between 0.1mm and 0.7mm in grain size, with a mode of 0.2mm. PV69 and PV74 are the coarsest-grained in the group, with inclusions measuring between 0.2mm and 1.9mm in grain size, with a mode size of 0.5 or 0.6mm. PV69 and PV74 further stand out from the rest in this group for their very angular inclusions, which can also be observed in sample PV79. The inclusions vary in their distribution, ranging from sparely spaced in some samples (PV68, PV71, PV68) to closely packed in the others

(PV69, PV74, PV79). Based on the high degree of internal heterogeneity in their relative abundance, size, shape, and distribution, it is postulated that the inclusions occurred naturally in the clay. The metamorphic nature of the inclusions is consistent with the geology of the Tortue-Amina-Malmon terrane, suggesting that the raw materials used in producing the vessels might have been extracted from the western part of the Ciabo Valley.

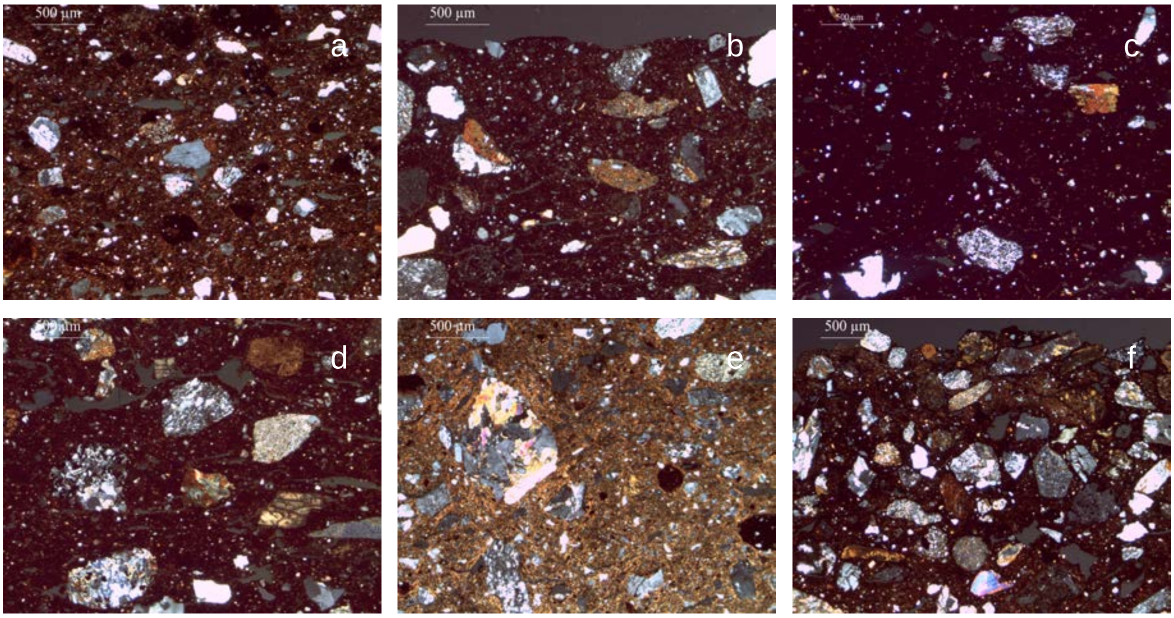


Figure 5. Photomicrographs showing the great internal heterogeneity of the relative abundance, size, shape and sorting of inclusions of the samples of the Amphibolite-Quartzite Group: (a) PV68, (b) PV69, (c) PV71, (d) PV74, (e) PV75, and (f) PV79. All photomicrographs are taken in XP and at x50 magnification.

Despite the observed variation, the inclusions and voids of all samples do not exhibit preferred orientation. Also, all samples have distinctive dark paste colour, indicating that the vessels were likely fired in a reducing atmosphere. The presence of darkened paste along the exterior margin of PV75 and PV79 further implies that the vessels were subjected to burning. In all cases, the clay matrices have moderate to low optical activity, suggesting that the vessels were fired at temperatures higher than the vessels of the Quartz Group and Grog-tempered Group. This petrofabric group is only associated with the black wares.

V.4. Other fabrics (N=3)

Sample no.: PV72, PV73, PV81

There are three samples of black wares that cannot be placed into the aforementioned petrofabric groups, owing to their distinctive mineralogical and textural features. PV72 is recognisable for its well-sorted fine-grained paste, which is characterised by abundant quartz inclusions, measuring between 0.1mm and 0.5mm, with a mode size of 0.1mm (Fig. 6a). No preferred orientation can be observed in the alignment of inclusions and voids. Another distinguishing feature of this sample is the presence of darker stripes of clay throughout the entire sample, which might be indicative of clay mixing. The darker paste colour of this sample suggests that the vessel was fired in a reducing atmosphere, whereas the optical inactivity of the clay matrix points to firing temperatures higher than other early colonial indigenous ceramics in this study.

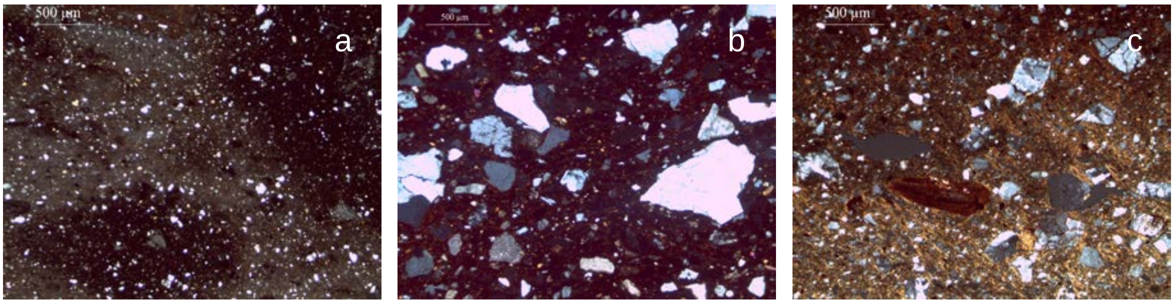


Figure 6. Photomicrographs showing outlier samples: (a) mixing of two clays of PV72, (b) PV73, and (c) PV81. All photomicrographs are taken in XP and at x50 magnification.

PV73 is characterised by abundant quartz inclusions, which are more angular and coarser-grained than the samples of the Quartz Group (Fig. 6b). The quartz inclusions of this sample range from 0.1mm to 1.3mm in grain size, with a mode size of 0.4mm. The quartz inclusions are found in association with common amphibole and amphibolite, and few to rare Fe-rich clay nodules and pellets, and plagioclase feldspar. The inclusions and voids do not display any preferred orientation. The darker paste colour of this sample suggests that the vessel was fired in a reducing atmosphere, whereas the low optical activity of the clay matrix points to higher firing temperatures.

PV81 is characterised by abundant quartzite fragments, which measure between 0.2mm and 1.3mm, with a mode size of 0.4mm (Fig. 6c). In addition to the quartzite fragments, the sample is characterised by common quartz and Fe-rich clay nodules or pellets, few plagioclase feldspar and amphibolite. With the exception of the Fe-rich clay nodules or pellets, all inclusions ranges from 0.2mm to 1.2mm in grain size, with a mode of ca.

0.2mm. The Fe-rich clay nodules or pellets are slightly coarser-grained, measuring between 0.2mm and 1.6mm, with a mode of 0.6mm. The inclusions and voids do not exhibit any preferred orientation. The presence of darkened paste along the exterior margin of the sample suggests that the vessel might have been subjected to burning.

VI. Discussion

VI.1. The production of indigenous ceramics during pre-colonial times

Before assessing which aspects of indigenous pottery production were more susceptible or resistant to change during the early colonial times, it is of crucial importance to understand how ceramics were produced in the Greater Antilles, particularly Hispaniola, during the pre-colonial times. For this purpose, we specifically referred to the results of the analysis we had previously conducted on a selection of pre-colonial ceramics as the basis of comparison (Ting et al., 2016). We carried out petrographic analysis on 32 samples of ceramics of Meillacoid, Chicoid and a mixture of Meillacoid and Chicoid styles that were recovered from the pre-colonial archaeological sites of La Luperona and El Flaco (Fig. 2) in northwest Dominican Republic (Hofman and Hoogland 2015; Hofman et al. 2014; Hofman et al., in press). Owing to their strategic location along the so-called 'Ruta de Colon', it is believed that the evidence retrieved from these two sites would have provided invaluable insights into the organisation and nature of indigenous society, especially during the period before initial encounter with Europeans.

Our results revealed that pottery production during the pre-colonial period was characterised by the following features: (1) A great variety of raw materials were used, as reflected in the identification of three main petrofabric groups, each with its associated subgroups; (2) Provenance studies of the petrofabric groups suggested that some vessels, especially those from the Amphibolite Group and Quartzite Group, were made by raw materials procured from sources local to the sites of recovery; (3) All petrofabric groups display high degree of internal heterogeneity in mineralogical and textural characteristics, implying low level of standardisation in preparing the ceramic pastes and/or reflecting little effort by pottery producers in homogenising the natural variation that existed in the raw materials; (4) Coiling was the primary forming method, as evident in the presence of relic coil in some vessels macroscopically; (5) Gouge-incision, punctation, modeling and appliques were among the common modes of decoration used to adorn the external surface of vessels; (6) The vessels were fired in a wide range of redox atmospheres and low temperatures, which indicate the use of open firing method; (7) There was a lack of production specialisation, in which no petrofabric group and subgroup was linked to a specific ceramic style or recovered from a specific site. Regarding the last observation, we further argued that the pre-colonial communities might have shared or exchanged the idea of the indigenous way of producing pottery.

We are aware of the technologies and production system as observed in the Meillacoid and Chicoid ceramics may not be representative of the technologies and production systems under which other pre-colonial ceramics were made. Nonetheless, until more analyses on pre-colonial ceramics in the region are available, the results of our previous study serve to provide a starting point to compare how similar and difference were the manufacturing technologies used to make early colonial indigenous and pre-colonial ceramics.

VI.2. The production of indigenous ceramics during early colonial period

VI.2.1. Raw materials selection

A great variety of raw materials were used to produce indigenous ceramics during both early colonial and pre-colonial periods, as evident in the identification of the three main petrofabric groups for the red wares and black wares and three for the Meillacoid and Chicoid ceramics. In both cases, raw materials were mostly extracted from sources local to the sites of recovery, as revealed by the potential provenances of the aplastic inclusions that are present in ceramic pastes. Whether the clays used to make indigenous pottery were obtained from local or non-local sources warrants systematic clay samplings in the regions as well as further chemical analysis. Since we have established that local raw materials were used in their production, the lack of overlap between the ceramic paste recipes involved in the production of early colonial indigenous and pre-colonial ceramics is simply related to, and thus reflective of, a change in the location of the potting communities. It is apparent that the early colonial and pre-colonial producers shared similar raw materials procurement strategy in making ceramics, that is the use of local raw materials from multiple sources by different producers contemporaneously.

The identification of grog temper in some red ware samples is of particular interest, as it was absent from our pre-colonial samples. That being said, the use of grog temper has been noted in other examples of pre-colonial ceramics in the Caribbean – including the adornos from the site of El Cabo, Dominican Republic (Guzman, 2015), as well as the pottery from the Lesser Antilles (Fitzpatrick et al., 2008; Hofman, 1993; Hofman et al., 2008; Lawrence et al., 2016) – highlighting that the use of grog temper was part of indigenous manufacturing technologies. Based on this finding, we hypothesise that the addition of grog temper in making the red wares indicates some inference from a different indigenous tradition, i.e. they were either potters from a different line of cultural transmission, or they had learnt from people from a different indigenous background. The underlying implication of this hypothesis is that the producers of the red wares needed to be informed about the need or convenience to add grog for symbolic or technical considerations (Tite et al., 2001: 310; Wallis et al., 2011).

VI.2.2. Paste preparation method

Perhaps the most distinguishable feature of the production of early colonial indigenous ceramics is the beginning of the development of product specialisation (Rice 2015: 361). Product specialisation, here, is defined as the use of specific ceramic paste recipe to produce specific type of pottery. This is evident in the clear distinction of the ceramic paste recipes used to make the black wares and red wares. The method used in preparing the ceramic pastes for the black wares largely followed the indigenous method characteristic of the Meillacoid and Chicoid ceramics, which is marked by great internal heterogeneity in the overall and relative abundance, size, and sorting of aplastic inclusions; all of which point to a low degree of standardisation. This contrasts sharply with the ceramic paste dedicated to producing the red wares, which is characterised by high degree of standardisation, as reflected in great degree of homogeneity in the overall abundance, size, and sorting of aplastic inclusions in these samples. Arguably, the use of different paste preparation methods in producing the black wares and red wares might be attributable to different vessels' function, with the black wares being used for cooking and the red wares for serving. Nonetheless, such distinction was not observed in the production of pre-colonial ceramics, in which the same paste recipe was used in making ceramics of Meillacoid, Chicoid, and a mixture of Meillacoid and Chicoid styles.

VI.2.3. Forming method

The forming method used to make the early colonial indigenous ceramics, particularly the black wares, appears to be consistent with their pre-colonial counterparts. Coiling was the primary forming method of the black wares, as evident in the identification of relic coils on the interior surface of some samples. As for the red wares, the recognition of the forming method is not as straightforward because no relic coils were observed on the surface of vessels. Yet, it is still possible that coiling was used to form the red wares with their surfaces being smoothed to the point where the relic coils were not detectable. It is equally possible that other hand-forming methods such as slab-building were used to form the vessels, although our present macroscopic and microscopic evidence does not provide sufficient proof to indicate which hand-forming method was used. This finding aligns with other examples of indigenous ceramic production in the Americas during the colonial period, in which hand-forming methods continued to be the principal forming method used by producers to make pottery (cf. Hernández Sánchez, 2011: 219-220; Rodríguez-Alegría et al., 2003; Ramon and Bell 2003; Rice, 2013; Sillar, 1996, 1997).

VI.2.4. Surface finishing method

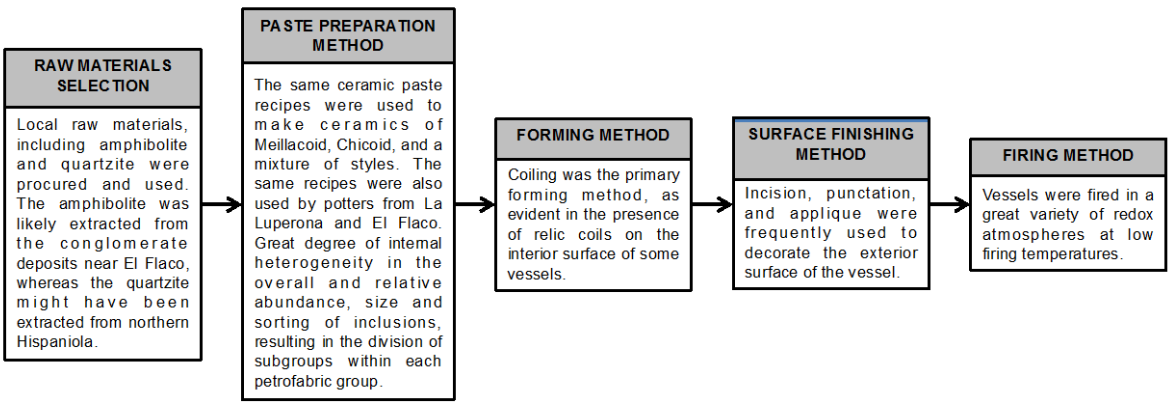
Indigenous modes of decoration such as gouge-incision, punctation, modeling and applique, which were commonly used to decorate the Meillacoid and Chicoid ceramics, were not used to decorate the black wares and red wares. Instead, the black wares were generally undecorated, whereas the exterior surface of the red wares was covered by a thin layer of red slip. Further examination on the composition of the slip layer by microscopic analytical techniques such as SEM-EDS is required to determine whether the same clay but with refinement and addition of iron oxide or a completely different clay was used to make the slip of red wares. The use of red slip in decorating the red wares is a particularly interesting technological choice. This is because red slips were commonly used to decorate pre-colonial ceramics that were found elsewhere in the Caribbean (Bérard, 2013; Cruxent and Rouse, 1958/ 1959; Roosevelt, 1980; Vargas Arenas, 1981), even though examples of pottery with red slips were rarely found in pre-colonial Hispaniola. Thus, the use of slips in decorating the red wares may suggest the possible transmission of an aspect of indigenous manufacturing technologies that had roots other than Meillacoid and Chicoid ceramics.

VI.2.5. Firing method

Unlike the pre-colonial ceramics, which were fired in varying redox atmospheres, the black wares were mostly fired at a reducing atmosphere, whereas the red wares were fired in an atmosphere that had achieved complete oxidation. Yet, the black wares and red wares were fired at low temperatures as reflected in the optical activity of their clay matrices in crossed polarisation. This argument is indeed supported by the results of Mössbauer analysis of indigenous ceramics from another early colonial site of La Isabela, Dominican Republic, which revealed that the vessels were fired at temperatures above 700°C but did not reach 950°C (Sbriz et al., 1989: 294). Thus, we postulate that an open firing method was used in the production of both early colonial indigenous and pre-colonial ceramics, but the producers appear to have displayed greater knowledge in how to control the firing atmosphere during the early colonial period.

VI.2.6. The transmission of indigenous technologies in the production of black wares and red wares

By outlining and comparing the five aspects of production (Fig. 7), it has become apparent that the production of black wares and red wares neither a direct learning (hypothesis 1) nor complete discontinuation (hypothesis 3) of the pre-colonial technologies, as seen in the Meillacoid and Chicoid ceramics. Instead, the producers of both black wares and red wares continued to use certain aspects of indigenous technologies (hypothesis 2). Yet, the aspects of indigenous technologies that were being continued or discontinued vary between the black wares and red wares, with the degree of local indigenous influences being more obvious in the production of black wares than red wares. The production of black wares followed the indigenous technologies typical of Meillacoid and Chicoid ceramics in terms of selecting local raw materials, low level of standardisation in ceramic paste preparation, the use of coiling, and low firing temperatures in open firing method. As for the red wares, it is certain that the use of local raw materials and low firing temperatures in open firing method represent a continuation of local indigenous technologies, whereas the use of grog temper and red slip might also represent the transmission of other indigenous technologies, which were not necessarily linked to the Meillacoid and Chicoid ceramics.



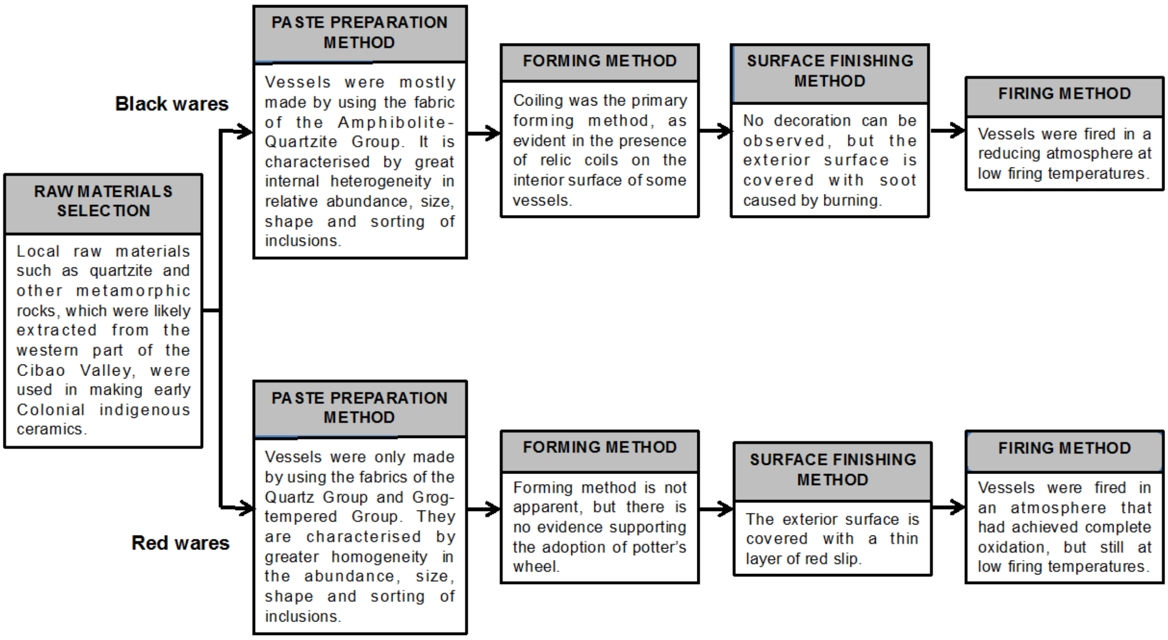


Figure 7. The technological choices involved in the production of pre-colonial Meillacoid and Chicoid ceramics from El Flaco and La Luperona (above), and early colonial indigenous ceramics from Cotuí (below).

We offer two possible explanations for varying extents of indigenous technologies that were continued to be used in the production of the black wares and red wares. The first explanation is that such variation might have been related to the difference in vessels' function (Schiffer and Skibo, 1987), as suggested in Section VI.2.2. This is because the vessels that were intended for cooking and other food preparation activities require different performance characteristics, such as thermal shock resistance, from those used for serving (cf. Tite and Kilikoglou, 2002; Tite et al., 2001). The producers chose to continue with specific aspects of indigenous technologies that would have enhanced the performance characteristics of the vessels for their intended purposes; and if this was the case, the producers are said to have displayed a high level of skill and technological know-how. The second explanation is that the black wares and red wares were produced by two different groups of producers, as many previous ethnographic and archaeological studies have shown that technological styles are symbols or expressions of socio-cultural groups (cf. Hegmon, 1998; Lechtman, 1977; Roux and Courty, 2015; Stark, 1998). In this sense, given the greater degree of similarity between the black wares and Meillacoid and Chicoid ceramics in terms of their production technologies, the producers of black wares seem to have exhibited closer affinity with the people or groups producing Meillacoid and Chicoid ceramics. The producers of red wares, on the other hand, might have been related to indigenous cultures with different roots, although analysis of other classes of artefacts from the same context of recovery, as well as ceramic evidence dating to the eve of colonial encounter from elsewhere in the Caribbean, is warranted to verify this hypothesis. Whereas this hypothesis seems to be a bit farfetched, it could be possible as what is missing from our existing research framework is the enormous movement of peoples from the beginning of the conquest from all over the Caribbean (Hofman et al., in press), which in turn might have significant implications on the exchange of technologies among different groups of indigenous populations.

VII. Conclusion

The results of this study not only confirm the contribution of indigenous technologies in the production of early colonial ceramics in the Greater Antilles, but also reveal that indigenous technologies were adopted to different extents, as reflected in the production of black wares and red wares at Cotuí. This study has further highlighted the role played by pottery producers in facilitating the transmission of certain aspects of indigenous technologies in their production, which might be related to practical and/or socio-cultural factors. Thus, all these serve to add an extra dimension, which is integral to our definition of transculturation between indigenous populations and European colonisers in shaping the early colonial material culture in the Greater Antilles. In addition, this study has demonstrated the value of integrating anthropological theory of cultural transmission and archaeological science to provide a fine-grained analysis of technology transmission in the context of colonial encounter, despite our small sample size. We propose that that this integrated approach has great potential of applying to the study of other ceramic assemblages in the region – especially the ones dating to continuous phases of occupation between the late pre-colonial and early colonial periods – which will help refining our initial hypotheses and unveiling more processes through which indigenous and even European technologies were exchanged.

Acknowledgements

This research has been conducted in the context of the NEXUS1492 Synergy-project and has received funding from the European Research Council under the European Union's Seventh Framework Programme (FP7/2007-2013)/ ERC grant agreement n° 319209. The first author is particularly grateful to Marcos Martinón-Torres for his insightful comment on the paper. Thanks should be given to all members of staff and students that took part in the excavation and research of La Luperona and El Flaco during the 2013 field season, as well as to Herman Nijs for preparing the thin sections.

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