



Isotopic study of geographic origins and diet of enslaved Africans buried in two Brazilian cemeteries



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ABSTRACT

Brazil was the main destination of enslaved Africans during the eighteenth and nineteenth centuries in the New World. We have analyzed isotopes of carbon, nitrogen and strontium in the enamel and dentin of teeth derived from remains of 41 enslaved Africans excavated in Pretos Novos cemetery (Rio de Janeiro) and Sé de Salvador cathedral (Salvador) in order to investigate aspects related to the geographical origins and dietary habits in Africa in these two groups with differing histories.

Strontium isotope results indicate a wide range of geographical origin for the analyzed individuals of both cemeteries, being significantly wider in Pretos Novos. Carbon and nitrogen isotopes results suggest that the diet of most individuals was based on plants. Only 26% probably had access to a significant amount of animal protein. The results also show that while some individuals were consuming C3 plants such as yams and manioc, others had a diet based more on C4 plants such as sorghum, millet and maize.

Interpreted in conjunction with archaeological and historical evidence, the findings of this study, including the high variability of $^{87}\text{Sr}/^{86}\text{Sr}$, $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$ values, contribute to the process of reconstructing the dramatic history of slavery in Brazil and in the Americas.

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1. Introduction

The transatlantic trade of enslaved Africans is intimately linked to Brazilian history, primarily because slavery was present in the country between 1550 and 1888, a period much extended in comparison with other colonies. Moreover, throughout this era, Brazil was the main destination of slave ships in the Americas (Klein and Luna, 2010) and received approximately 40% of the 10.5 million slaves who arrived in the region (Florentino, 2002). Between 1700 and 1830, the main port of disembarkation of slaves

was Rio de Janeiro, which received approximately 1,200,000 individuals, which accounted for 50% of the total slave trade in the country. During a similar period (1678–1830), the port of Salvador received around 790,000 slaves representing some 30% of the Brazilian slave trade. It is estimated that these two ports alone received one-third of all slaves traded in the Americas during that time (Florentino et al., 2004). At the end of the twentieth century, dozens of human remains associated with the period of slavery were discovered in the long-forgotten cemetery of Pretos Novos in Rio de Janeiro and in the churchyard of the former Sé de Salvador cathedral in Salvador.

In the present study, we have analyzed carbon ($\delta^{13}\text{C}$) and nitrogen ($\delta^{15}\text{N}$) stable isotopes and strontium isotopes ($^{87}\text{Sr}/^{86}\text{Sr}$) in the enamel and dentin of 41 individuals derived from the remains of enslaved Africans found in Pretos Novos cemetery and Sé de Salvador cathedral in order to investigate the geographical origins

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and dietary habits of the captives prior to their arrival in Brazil.

Isotope analysis has proven to be a valuable tool in elucidating the origins of ancient people and various aspects relating to their way of life (Schweissing and Grupe, 2003; Price et al., 2002). Such studies have provided important insights into the migration and diet of enslaved Africans buried in cemeteries in Campeche (Mexico) (Price et al., 2012), Barbados and Saint Martin islands (Caribbean) (Schroeder et al., 2009, 2012) and New York City (USA) (Goodman et al., 2004).

2. Historical background

2.1. Pretos Novos cemetery

The Pretos Novos cemetery is located in the port area of Rio de Janeiro, less than 500 m from Guanabara Bay and in the neighborhood presently known as Gamboa. The cemetery operated from 1769 until 1830 and was used to bury recently arrived captives from Africa who had died prior to being sold in the Valongo market (Pereira, 2007; Machado, 2006). The need to create a cemetery exclusively for enslaved newcomers can be explained by the increasing number of African captives arriving in Rio de Janeiro following the discovery of gold in the interior of Brazil at the end of the seventeenth century (Pereira, 2007), and by the need to control contagious diseases. As is common in other contemporary Christian cemeteries for the poor and indigent, the bodies that arrived at Pretos Novos were stacked in mass graves, often remaining unburied for days and sometimes burned. The exact number of slaves buried in this cemetery during its *ca.* 60 years of operation is not known but is estimated to be on the order of 20,000. According to the archives of the Church of Santa Rita, more than 1000 slaves were buried in the cemetery each year during the last six years of operation. An incessant stream of complaints from local residents led to the official closure of Pretos Novos in 1830 coinciding with the suspension of the legal slave trade in Brazil (Pereira, 2007). Although the slave trade continued illegally over the years, the cemetery was no longer used officially. The site was redeveloped in the ensuing decades as a residential area and details of its historic function were forgotten (Tavares, 2012).

Rediscovery of the Pretos Novos cemetery occurred in 1996 during renovation work on a private residence when test foundations dug at depths between 0.5 and 1.5 m revealed the presence of thousands of human bones. The owners of the residence reported the find to the Department of Cultural Heritage of Rio de Janeiro city, and the Brazilian Institute of Archaeology (IAB) was appointed to conduct an archaeological rescue excavation. Studies of historical documents and analyses of bones and teeth confirmed that the location was consistent with descriptions of Pretos Novos cemetery (Machado, 2006). Despite the emergency nature of bone removal and the lack of systematic excavation, it was possible to verify from the documents filed by IAB that the burial site consisted of two stratigraphic layers. The top layer, which ranged from 0.9 to 1.0 m in depth, was made up of landfill material containing some human remains, bones of domestic animals and construction waste, together with numerous artifacts including glass beads, crockery, iron tools and other items dating from the nineteenth century. The lower layer comprised beach sand corresponding to the substrate in which the first burials were reportedly performed (Machado, 2006; Bastos et al., 2011). Comingled human remains were collected from this site without spatial or stratigraphic tagging and most were highly fragmented, with many showing signs of burning. Nevertheless, Machado (2006) was able to examine 5563 bone fragments and teeth recovered from the accidental discovery and reported the predominance of young male adults and of teeth showing intentional dental modifications that were characteristic of some African

groups (Fig. 1).

2.2. Catedral da Sé de Salvador

Construction of Sé de Salvador, the first cathedral to be built in Brazil, began in the upper part of Salvador city center around 1550, with successive extensions being added over the years. The cathedral churchyard served as a burial ground for all social strata of the city, including enslaved and freed African captives, from the mid-sixteenth century up until 1856 (Etchevarne et al., 1999). In accordance with contemporary custom, burials in the churchyard obeyed a certain hierarchy whereby rich folk were able to buy tombs nearer to the main altar.

In 1933, Sé de Salvador was demolished to make room for an extension to Salvador's tram system, and the bodies in tombs located in the inner portion of the cathedral were exhumed (Etchevarne et al., 1999; Tavares, 2006). In 1998 and 2001, archaeologists supervised by the team of the Archaeological Museum of the Federal University of Bahia (UFBA) carried out excavations at the original site of the cathedral. These investigations led to the identification of architectural structures, human remains, warfare materials, food remains, household objects and personal items such as saint medals, crucifixes and glass beads. Some of the personal items were associated with the remains and have been interpreted as grave goods (Etchevarne et al., 1999, 2001). Burial sites were located mainly in the cathedral churchyard with a few in the nave. However, some remains dating from the sixteenth century were located under the foundations of walls built during the construction of extensions to the cathedral. In 2006, Tavares (2006) investigated 421 entries in the cathedral's records of deaths in the eighteenth and nineteenth centuries and reported that 65% related to African individuals or their descendants (enslaved or freed).

Excavations revealed that the cathedral churchyard comprised a number of archaeological layers corresponding to successive landfills dating from the seventeenth, eighteenth and nineteenth centuries within which scattered human bones were found. Dozens of primary burial sites associated with the eighteenth century were found in the areas that were not part of the landfill at depths between 0.7 and 2.0 m, and some of these contained beads typical of the Niger region, reinforcing the African presence in the cemetery (Etchevarne et al., 1999, 2001). According to Liryo et al. (2011), of the 55 individuals in eighteenth century primary burial sites that could be examined in detail, 18 (32.7%) exhibited intentional modifications of the incisor teeth that were characteristic of African groups. Additionally, 40 loose incisors collected from the oldest landfills, including the churchyard of Sé de Salvador, exhibited some kind of intentional modification.

3. Isotopes in archaeology

3.1. Strontium isotopes

Information regarding the geographical origin of human remains may be gleaned from strontium signatures of body tissues. Among the four stable isotopes of strontium, ^{86}Sr and ^{87}Sr are reasonably abundant, but only the latter is radiogenic, being a product of the nuclear breakdown of rubidium (^{87}Rb) (Faure, 1986). Thus, old and Rb-rich rocks, in which radioactive decay of ^{87}Rb has occurred over a protracted period, exhibit $^{87}\text{Sr}/^{86}\text{Sr}$ ratios that are high in comparison with those of more recently formed rocks (Faure, 1986). Normally, $^{87}\text{Sr}/^{86}\text{Sr}$ ratios range between 0.703 and 0.750 depending on the nature and age of the rock, and values can be determined with high precision (up to five decimal places) using certain mass spectrometers (Price et al., 2006). Strontium isotopes do not undergo fractionation during the process of soil formation or

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