Fecal Sterol Biomarkers as Indicators of Population Change: an Example from the Cahokia Archaeological Complex, Madison County, Illinois



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HUMAN GUT

What are fecal sterol biomarkers?

- Suite of organic molecules produced through microbial degradation in the guts of humans and other large mammals
- Typically introduced into the environment as fecal waste component
- Recalcitrant molecules persist in sediment for 100s 1000s of years





Major Sterol Biomarkers

Name	Parent Molecule	Produced in	Producers
Coprostanol	Cholesterol	Gut	Humans, Pigs
5β-Stigmastanol	Stigmasterol	Gut	Ruminants
5β-Campestanol	Campesterol	Gut	Ruminants
Epicoprostanol	Coprostanol	Sediment	Humans, Pigs
5β-Epistigmastanol	5β-Stigmastanol	Sediment	Ruminants
5β-Epicampestanol	5β-Campestanol	Sediment	Ruminants

Previous work

- Fecal sterol biomarker analysis originated in modern sewage studies
- Earlier archaeological applications focused on fecal sterol biomarker presence/absence:
 - 18th century agricultural fields in the UK (Simpson et al., 1999)
 - Bronze Age Minoan agricultural fields in Greece (Bull et al., 1999)
 - Roman cess-pits in the UK (Bethel et al., 1994)



Roman cess-pit, Bull et al., 2002

D'Anjou et al., 2012 – population change



 $\mu g\,(g\,OC)^{\text{-1}}$

µg (g OC)-1

Objectives

- At present, no standard fecal sterol biomarker methodology exists.
 Can a standard method be developed?
- The method has only been applied in an arctic climate. Does the method work in other climates?
- The method has only been applied in a northern European archaeological context. Does the method work in other demographic settings?

Study Area – Cahokia

- Temperate climate
- Intensely studied established population trend narrative
- Proximity to water Horseshoe
 Lake 1 km north of Cahokia
- Population Cahokia was the largest population center in the United States prior to the 19th century (Woods, 2004)
- No pigs coprostanol and epicoprostanol attributable to humans



Adapted from Munoz et al., 2014





Cahokia Results – Total Coprostanol + Epicoprostanol



Cahokia Results - Fecal Sterols : 5α-Cholestanol



Conclusion

- Fecal sterol biomarkers are capable of tracking population changes in a temperate climate and prehistoric North American archaeological context
- Saponification is recommended for future analyses
- Coprostanol + Epicoprostanol : 5α-cholestenol ratio stronger way of reporting values than amount alone
- Fecal sterol biomarkers support narrative of Cahokia's population rise and fall; however, population decline may have been more gradual than expected

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