



Universiteit
Leiden
The Netherlands

Evaluating the dietary micro-remain record in dental calculus and its application in deciphering hominin diets in Palaeolithic Eurasia

Power, R.C.F.

Citation

Power, R. C. F. (2016, November 1). *Evaluating the dietary micro-remain record in dental calculus and its application in deciphering hominin diets in Palaeolithic Eurasia*. Retrieved from <https://hdl.handle.net/1887/43970>

Version: Not Applicable (or Unknown)

License: [Licence agreement concerning inclusion of doctoral thesis in the Institutional Repository of the University of Leiden](#)

Downloaded from: <https://hdl.handle.net/1887/43970>

Note: To cite this publication please use the final published version (if applicable).

Cover Page



Universiteit Leiden



The handle <http://hdl.handle.net/1887/43970> holds various files of this Leiden University dissertation.

Author: Power, R.C.F.

Title: Evaluating the dietary micro-remain record in dental calculus and its application in deciphering hominin diets in Palaeolithic Eurasia

Issue Date: 2016-11-01

Evaluating the dietary microremain record in dental calculus and its application in deciphering hominin diets in Palaeolithic Eurasia

Proefschrift

ter verkrijging van

de graad van Doctor aan de Universiteit Leiden,

op gezag van Rector Magnificus prof. mr. C.J. J. M. Stolker,

volgens besluit van het College voor Promoties

te verdedigen op dinsdag 1 november 2016

klokke 16.15 uur

door

Robert Charles Fergal Power

Geboren te Waterford, Ierland

in 1989

Promotor: Prof. dr. Jean-Jacques Hublin (Universiteit Leiden and the Max-Planck-Gesellschaft)

Co-Promotor: Dr. Amanda G. Henry (Max-Planck-Gesellschaft)

Co-Promotor: Dr. Domingo C. Salazar-García (University of Cape Town, and the Max-Planck-Gesellschaft)

Promotie commissie:

Prof. dr. Wil Roebroeks (Universiteit Leiden)

Dr. Alexander Verpoorte (Universiteit Leiden)

Prof. dr. Annelou van Gijn (Universiteit Leiden)

Dr. Geeske Langejans (Universiteit Leiden and the University of Johannesburg)

Prof. dr. Marco Madella (Universitat Pompeu Fabra)

Copyright © Robert C. F. Power 2016
All Rights Reserved

Cover design by Mariska Carvalho

This research has been made possible through a Max Planck Independent Research Group grant of the Max Planck Society, obtained by Dr. Amanda G. Henry. The research was supervised by Dr. Amanda G. Henry and Dr. Domingo C. Salazar-García.

Contents

Preface.....	1
Introduction: the evolutionary context of Neanderthal dietary ecology	3
Assessing use and suitability of scanning electron microscopy in the analysis of microremains in dental calculus	47
Dental calculus evidence of Taï Forest Chimpanzee plant consumption and life history transitions.....	67
Dental calculus indicates widespread plant use within the Neanderthal dietary niche	91
Discussion: A pathway for reconstructing Neanderthal Dietary Ecology.....	119
References	133
Appendixes	165
Summary	255
Samenvatting	257
Acknowledgements	259
Contributions.....	263
Curriculum vitae	265

List of Figures

Figure 1: The largest known range of Neanderthals.....	7
Figure 2: Conceptual illustration of a diet breadth model.....	12
Figure 3: Carbon wt % of starch, sugars and sugars produced by hydrolysis.....	56
Figure 4: Carbon wt % comparing native starch versus hydrolysed samples	56
Figure 5: Starch grains located <i>in-situ</i> on dental calculus surface.....	58
Figure 6: SEM image showing microremain diversity	59
Figure 7: SEM image showing localised damage that arises from higher primary voltage....	59
Figure 8: A calcium oxalate prism observed with optical microscopy.....	62
Figure 9: Starch and phytolith morphotypes used in the identification model	78
Figure 10: Microremains recovered in dental calculus samples.....	80
Figure 11: Microremain assemblages recovered in calculus.....	81
Figure 12: Plant genera represented by microremains and Chimpanzees diet.....	83
Figure 13: Mixed poisson regression model predicted values	85
Figure 14: Abundance of <i>Coula</i> nut starches with chimpanzee age at death.....	87
Figure 15: Map of western Eurasia with the studied sites indicated.....	96
Figure 16: Miroremains from Neanderthal calculus, fauna calculus and controls.....	109
Figure 17: Mosaic of microremains and modern reference plant matter	112
Figure 18: A Menhinick's index of types of starch and phytolith and climate	114
Appendix figure 1: Starches per mg in each chimpanzee sample and year of death.....	175
Appendix figure 2: Chimpanzee plant foods, ranked by minutes consumed	176
Appendix figure 3: Total numbers of starch and phytoliths in each Neanderthals site	251

List of Tables

Table 1: Energy yields of various food classes consumed by recent foragers	16
Table 2: Neanderthal sites with evidence of macrobotanical plant remains	28
Table 3: Neanderthal remains with published stable isotopic values	37
Table 4: Calculus samples analysed using SEM-EDX and OM	52
Table 5: List of reference samples analysed using EDX	53
Table 6: Recovered microremains using both microscopy approaches.	61
Table 7: Plant genera selected from reference collection for the identification model.....	71
Table 8: All chimpanzee dental calculus samples analysed.....	73
Table 9: Neanderthal dental calculus samples.....	102
Table 10: Palaeoenvironmental simulations used to predict seasonal temperature	105
Table 11: Palaeoenvironment reconstructions for each specimen used in this study	106
Appendix table 1: Elemental composition of standards.....	165
Appendix table 2: Elemental composition of degraded and native starch	166
Appendix table 3: Elemental composition of calculus and microremains in calculus.....	168
Appendix table 4: Inventory of analysed plants and fungi	177
Appendix table 5: Additional details of Chimpanzee calculus samples.....	181
Appendix table 6: Metrics of reference phytoliths and starches	182
Appendix table 7: Microremain variables used for identification model	202
Appendix table 8: Random forest phytolith identification model	202
Appendix table 9: Random forest starch identification model.....	203
Appendix table 10: All recovered microremains in each dental calculus sample	204
Appendix table 11: Counts of identified genera in Taï Chimpanzee calculus samples.....	208
Appendix table 12: Measurements of phytoliths and starch from calculus	208
Appendix table 13: Coefficients of statistical models	237
Appendix table 14: Variable importance in phytolith and starch random forest	238
Appendix table 15: Total recovered microremains from Vindija.....	243
Appendix table 16: Total recovered microremains from Grotta Guattari	246
Appendix table 17: Total recovered microremains from Grotta Fossellone	248

Appendix table 18: Total microremains from Sima de las Palomas del Cabezo Gordo	249
Appendix table 19: Total microremains from Kalamakia	250
Appendix table 20: Coefficients of statistical models	252
Appendix table 21: Western Eurasian starch-rich economic plants	252