Assessing the biomarker potential of lipids derived from pollen from a variety of plants

Sjoerd Drijfhout, Francien Peterse, Klaas Nierop

Department of Earth Sciences, Faculty of Geosciences, Utrecht University, Princetonlaan 8, 3584 CB Utrecht, the Netherlands

Introduction

n-Alkanes are predominantly present in the waxy epicuticular layers of leaves of terrestrial plants. They are frequently produced by these plants in order to protect them against dehydration [1]. Alkanes are well-known to have a strong odd-over-even predominance in their carbon chain lengths [2] and they are one of the widely used plant biomarkers in the world [1]. There is, however, still little known about their function (and that of other lipids) within pollen grains. Therefore, a more detailed investigation on pollen lipids is needed, with a specific focus on the differences between pollen lipids and the lipids that are found within leaf waxes coming from the same plants.

Aims

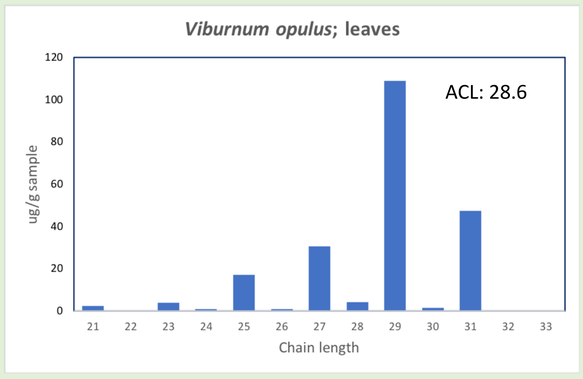
- The difference in lipid composition between pollen and leaves of the same plant species (or families).
- Why is there much/little of a specific lipid component and what function could this component have within the pollen?
- Is there a reason why pollen contain certain lipids that are not found within the leaf wax layer of a plant?

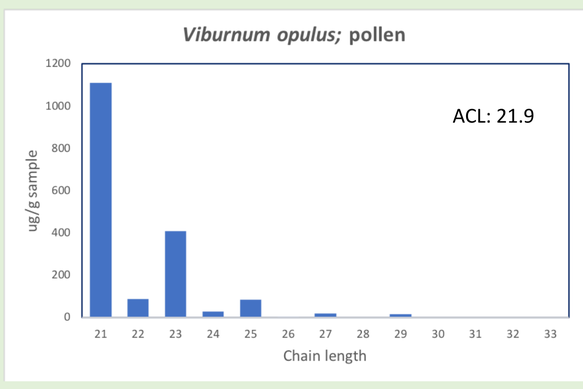
Method

Lipids are extracted from leaves and pollen of 15 different plant species and subsequently analysed using GC and GC-MS for quantification and identification.

Results

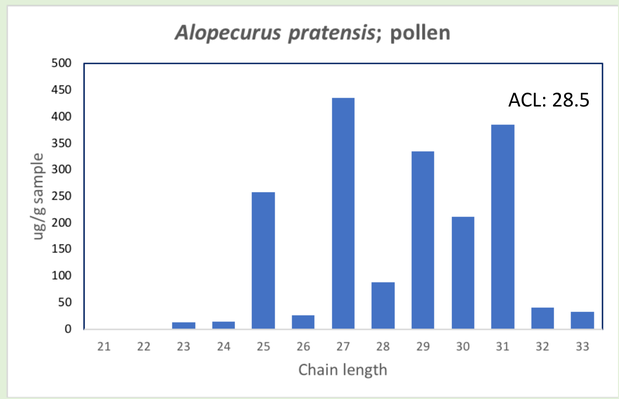
Alkanes





Concentration of *n*-alkanes is higher in pollen than in leaves.
The Average Chain Length (ACL) is usually higher in leaves than in pollen.

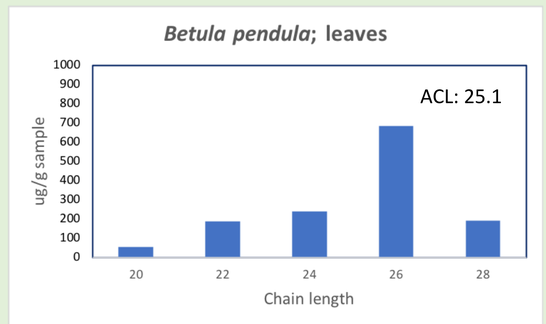
Alkenes

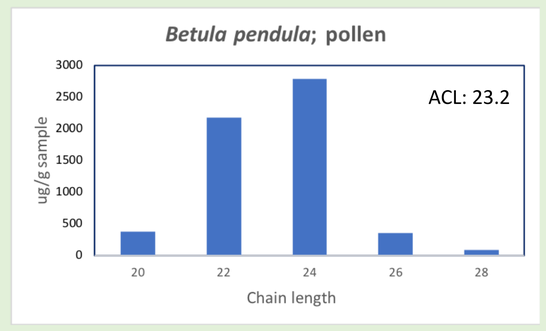


Most of the examined plant pollen contain *n*-alkenes. By contrast, leaves usually did not comprise them, except for two plant species: *Ginkgo biloba* and *Betula pendula.*

The pollen of the monocotyledons usually had higher ACL's than the dicotyledons.

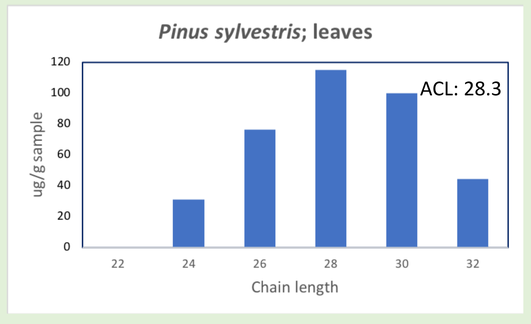
Fatty acids

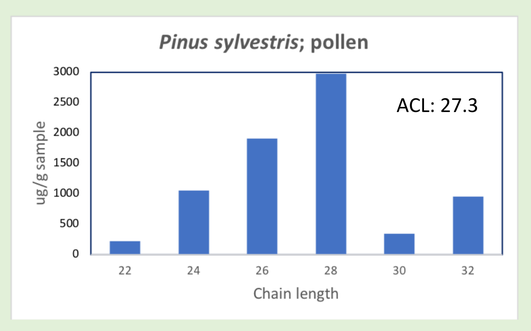




The fatty acids had very varying concentrations in both the pollen and leaves.
Of all species examined, the of pine pollen was relatively low (around 22) whereas that of *Betula pendula* pollen was more average.

Alcohols





Concentrations of alcohols were usually higher in leaves than in pollen, except for the pine species (like this example) and *Alnus viridis*.

For almost all species, the ACL was higher in leaves than in pollen.

Discussion / Conclusions

From the results obtained, the following (provisional) conclusions can be drawn based on the research aims:

- It appears that pollen contain higher concentrations of *n*-alkanes, and as was expected, are usually the only ones that contain alkenes. Alcohols are, however, found in higher quantities in the leaves of plants, except in case of the pine species.
- The different functions of lipid components in pollen is still debatable, but the high concentrations of alkanes that we see here suggest that the protection against dehydration must be at least of even importance in pollen as in leaves. The fatty acids and alcohols probably have a more cellular structural function. A likely possibility could be that the different lipid compartments together can perform protective functions for the plant in its specific environment, which is different for every plant species, hence the different lipid concentrations.
- Why alkenes appear in pollen and hardly/not in leaves is still a mystery: we are open to suggestions!

References:

[1] Bush, R.T. & McInerney, F.A. (2013). Leaf wax n-alkane distributions in and across modern plants: implications for paleoecology and chemotaxonomy. *Geochimica et Cosmochimica Acta*, *117*, 161-179.

[2] Zhang, Z., Zhao, M., Yang, X., Wang, S., Jiang, X., Oldfield, F. & Eglinton, G. (2004). A hydrocarbon biomarker record for the last 40 kyr of plant input to Lake Heqing, southwestern China. *Organic Geochemistry*, *35*(5), 595-613.