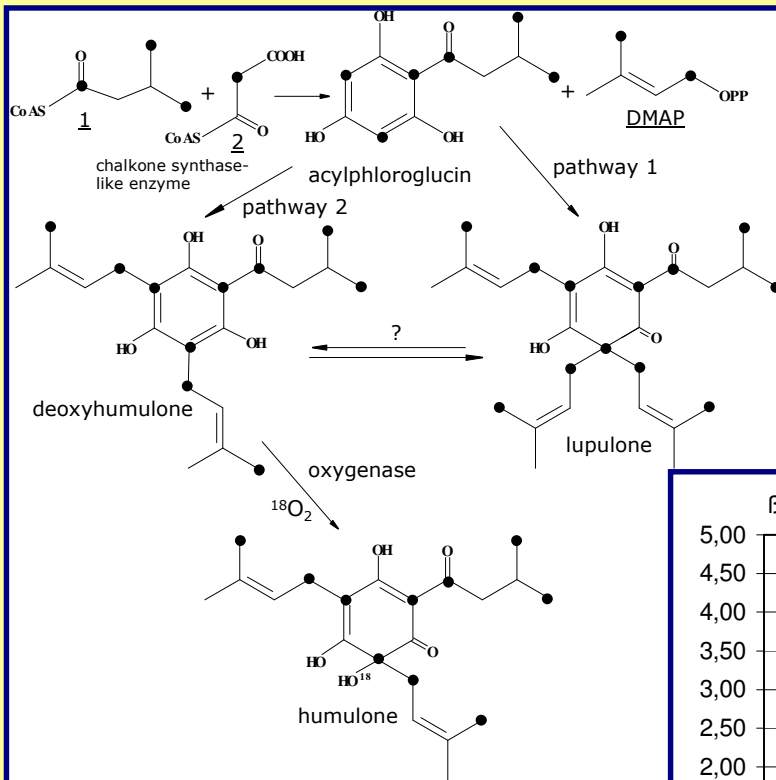


The biosynthesis of the bitter acids in hops

K. Kammhuber, M. Goese, S. Hecht

Introduction

The α -acids are considered to be the primary quality feature of hops, because they are a measure of the bitter potential. But also the β -acids are getting increasing importance for the food industry due to their antimicrobial and preservative properties. The following biosynthesis pathway is discussed in hops.



Method

Isotope incorporation experiments using [1-C13]-glucose [1] and $^{18}\text{O}_2$ [2] revealed the shown labelling pattern. The isotope enrichment identify isovaleryl-CoA 1, malonyl-CoA 2 and dimethylallyl pyrophosphate DMAP as precursors of humulone. The DMAP is generated via the deoxyxylulose pathway of the terpenoid biosynthesis. It is not clearly proved, whether the biosynthesis follows way 1 or 2.

Biosynthesis pathway of the α - and β -acids

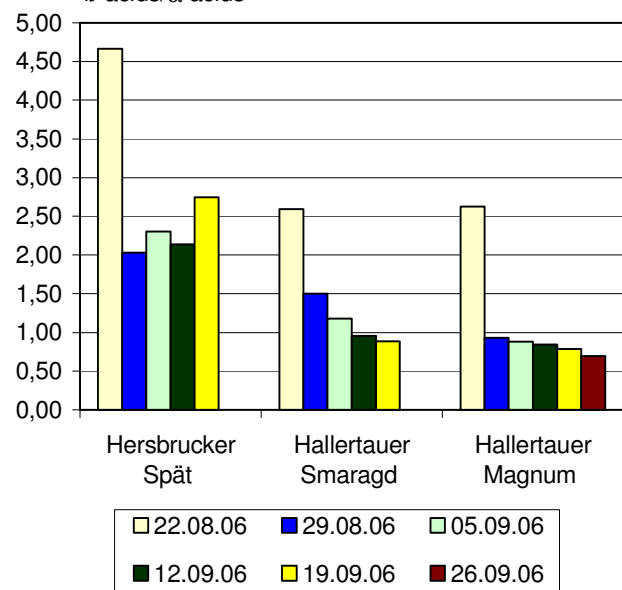
Discussion

Investigations into the bitter substances of hop leaves [3] have shown that β -acids are formed in small amounts (up to 0,3 %). Alpha-acids are only found in traces. During the biosynthesis of the bitter substances in cones first a surplus of the β -acids compared to the alpha-acids is observed. These facts speak for pathway 1.

Literature:

- Goese, M., Kammhuber, K., Bacher, A., Zenk, M. H., Eisenreich, W. (1999): „Biosynthesis of bitter acids in hops”, *Eur. J. Biochem.* **263**, 447-454 (1999)
- Hecht, S., Kammhuber, K., Reiner, J., Bacher, A., Eisenreich, W. (2004): „Biosynthetic experiments with tall plants under field conditions. $^{18}\text{O}_2$ incorporation into humulone from *Humulus Lupulus*”, *Phytochemistry*, 2004 Apr., **65** (8), 1057-1060
- Kammhuber, K. (1997): „Untersuchungen über die Inhaltsstoffe der Lupulindrüsen von Hopfenblättern und ihre Bedeutung für die Hopfenzüchtung”, *Monatsschrift für Brauwissenschaft*, Heft 11/12, 1997, 210-213

β -acids/ α -acids



Ratio of the α -/ β -acids during the biosynthesis