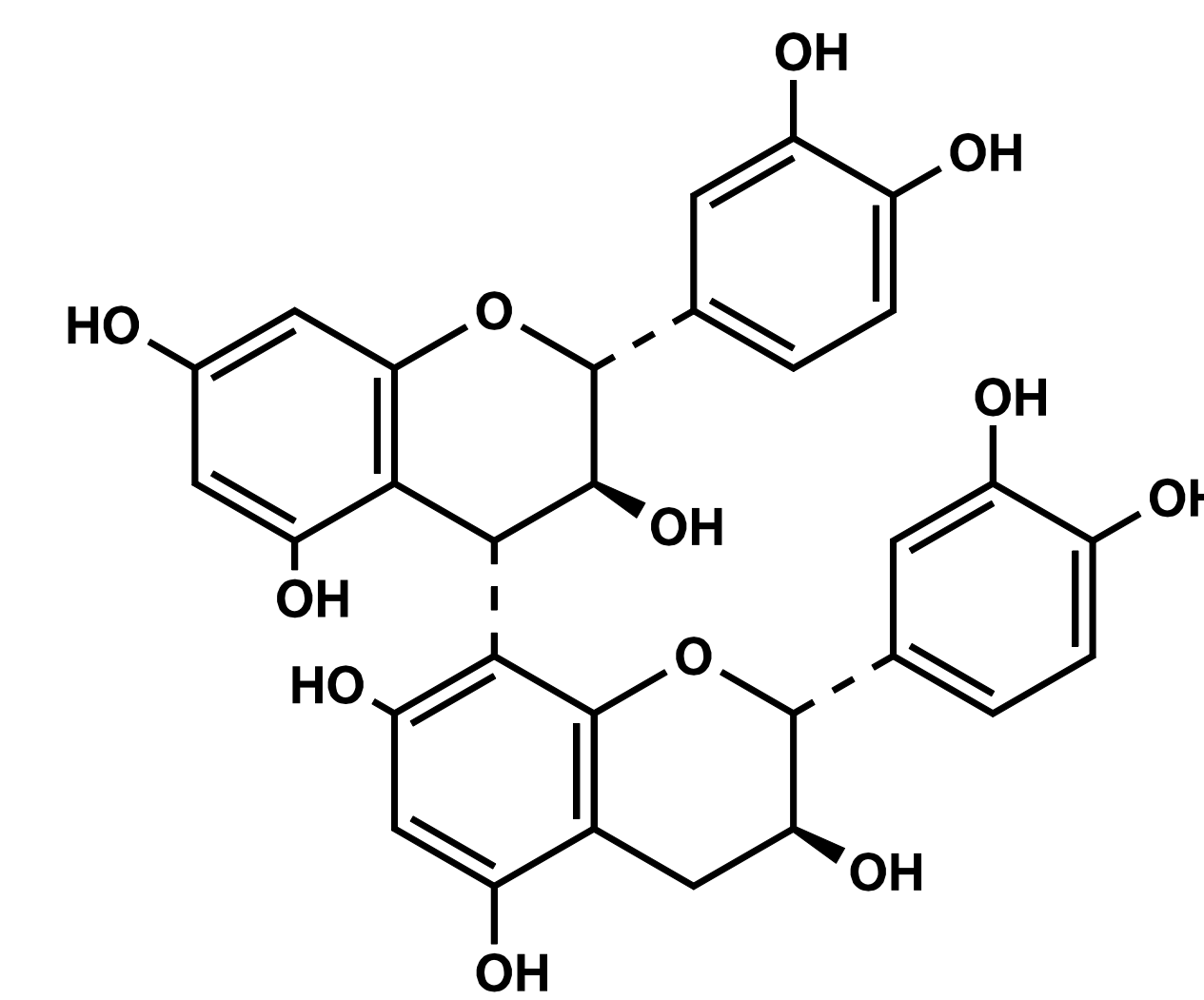


# LOW MOLECULAR POLYPHENOLS IN BEER INFLUENCED BY DIFFERENT HOP VARIETIES



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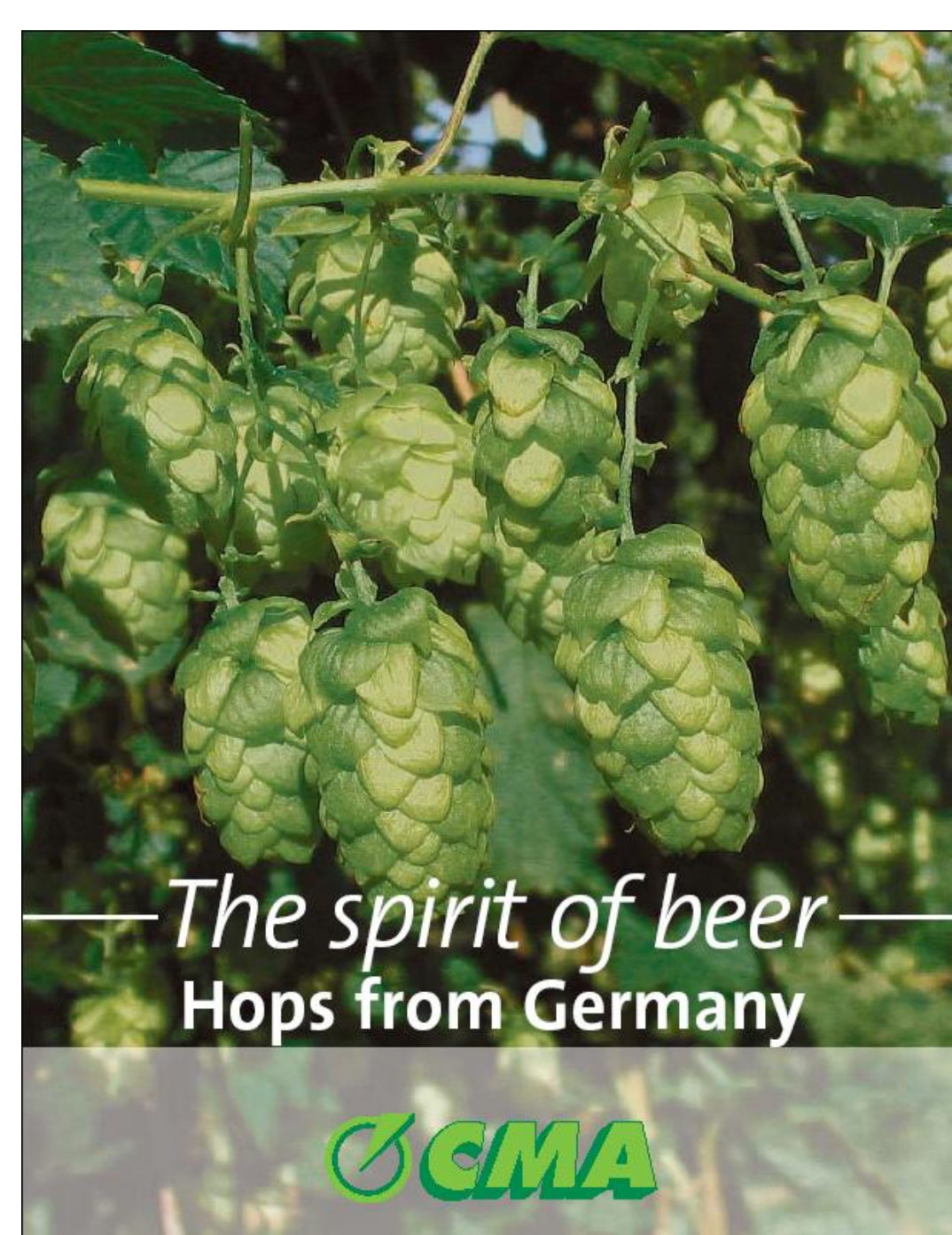
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## Introduction

During the last years polyphenols from hops attracted more interest to the pharmaceutical industry. The most important reason is the antioxidative power of some compounds. For brewers the influence of hop polyphenols on the beers is still a field of research.

The hop portfolio of the CMA gives splendid information about the German varieties and their influence on beers. For this work four selected varieties are compared. Their contribution to the composition of the low molecular polyphenols in the related beers is shown.

For comparison one beer was bittered without hop polyphenols only by means of a CO<sub>2</sub>-extract (variety Hallertauer Magnum).



## Methods and materials

To obtain comparable beers the following hopping rates were chosen for the brews ( 2 hl-scale):

	Hallertau Magnum	Hallertau Hersbruck	Tett nang	Saaz	Magnum Extract
Alpha (EBC 7.7)	12.4 %	2.6 %	4.0 %	2.7 %	49.0 %
Hopping rate 1	116.1 g	722.3 g	435.0 g	693.4 g	31.8 g
Hopping rate 2	77.4 g	481.5 g	290.0 g	462.2 g	0.0 g
Total hopping rate	193.5 g	1203.9 g	725.0 g	1155.6 g	31.8 g
Iso alpha acids in beer	22.1 mg/l	21.3 mg/l	24.6 mg/l	24.0 mg/l	20.9 mg/l

The polyphenol contents in the four selected hop varieties are quite different. This is also shown by the different levels of the substance groups:

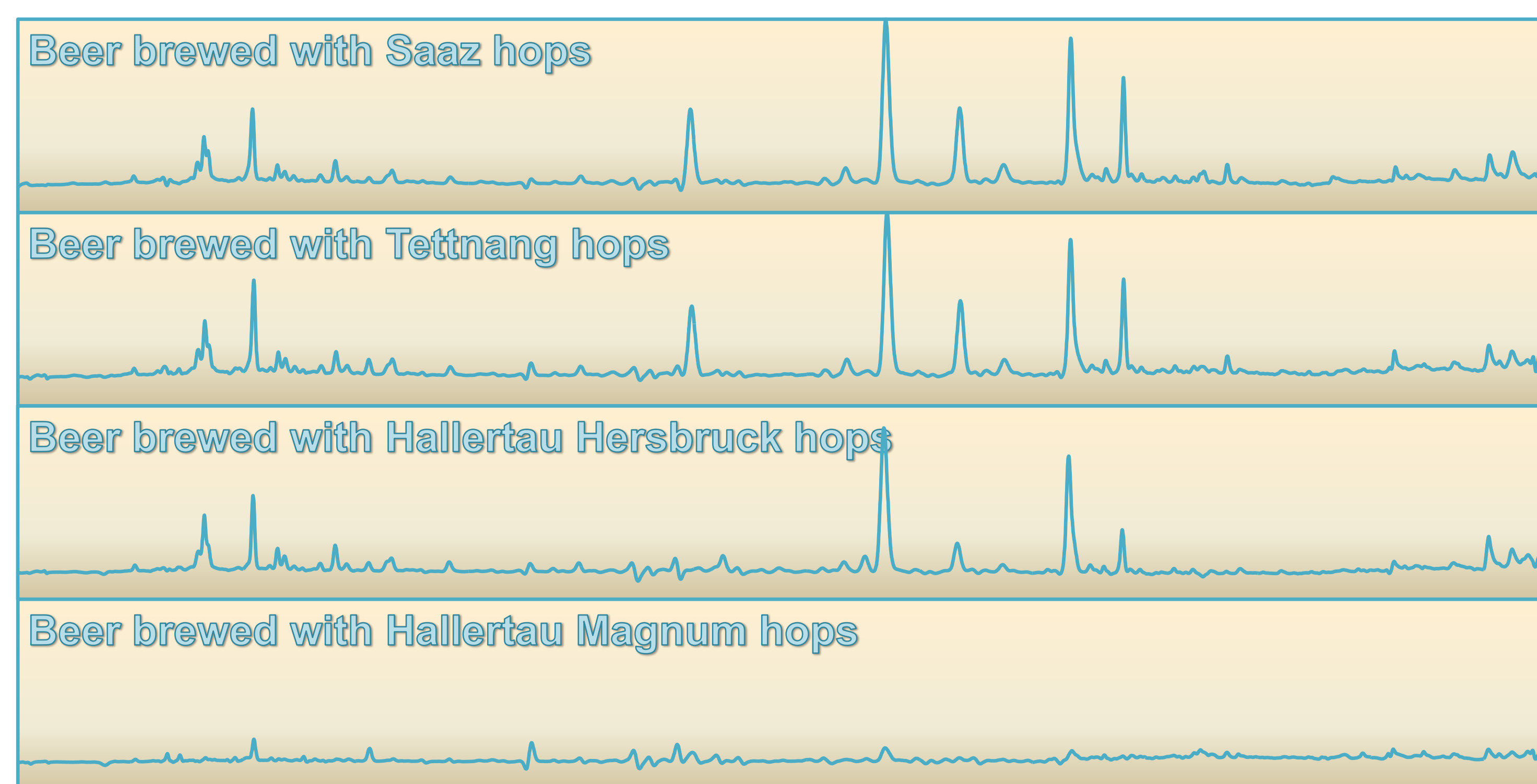
Values in mg/kg	Hallertau Magnum	Hallertau Hersbruck	Tett nang	Saaz
Hydroxy cinnamic acids	904	2407	2014	1297
Hydroxy benzoic acids	45	41	91	78
Flavanols	592	3406	3858	2408
Proanthocyanidins	1347	6181	7525	5606
Quercetin flavonoids	2082	3208	5748	4824
Kaempferol flavonoids	787	2084	2329	2081
Other flavonoids	22	27	23	21
Sum	6549	18041	23023	18567

The polyphenol contents in the different hop varieties influence the dosages of polyphenols to the beers. Additionally the dosage of polyphenols depends on the ratio polyphenols/alpha acids in the different hop varieties.

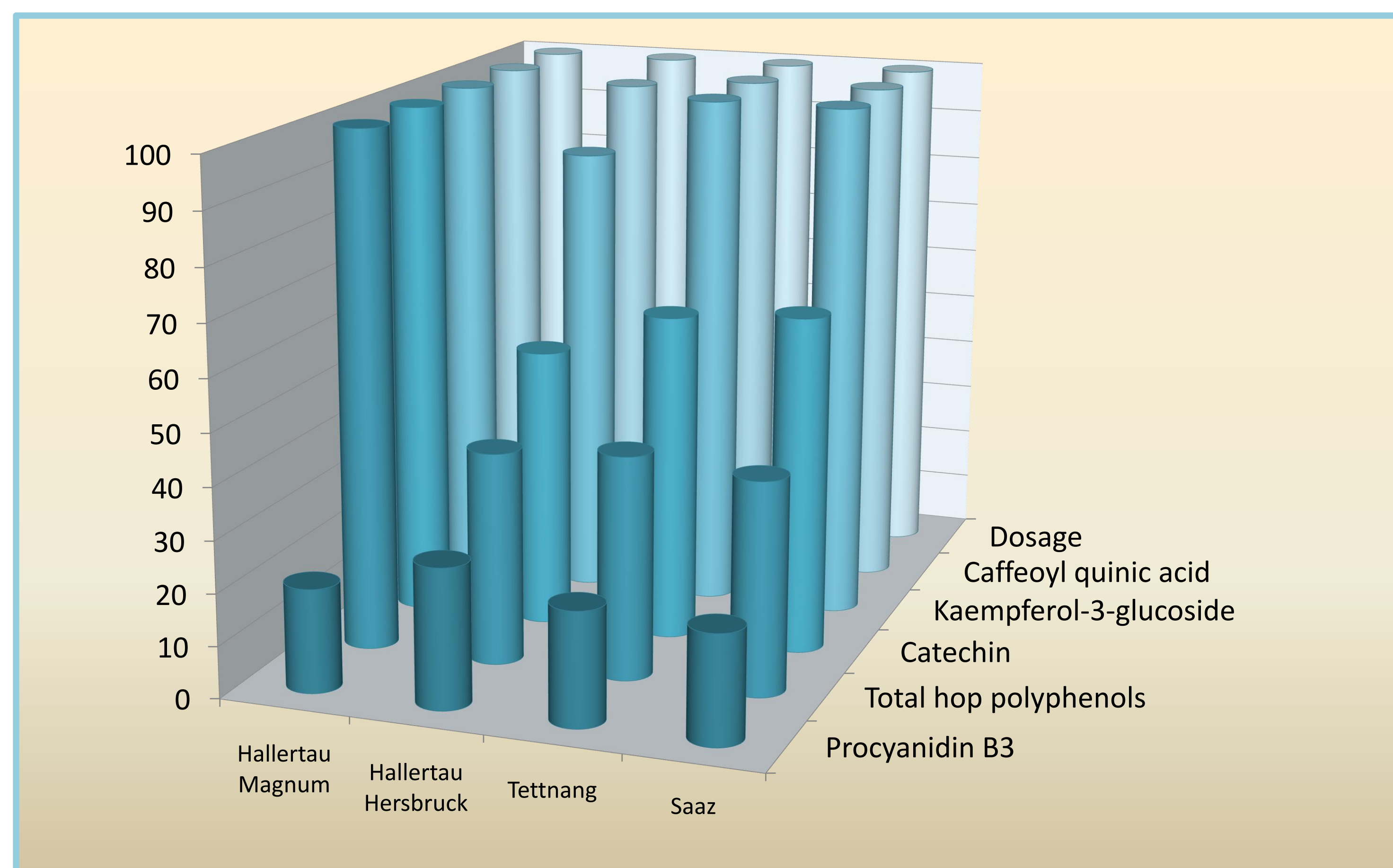
Values in mg/l	Hallertau Magnum	Hallertau Hersbruck	Tett nang	Saaz
Hydroxy cinnamic acids	0.9	14.5	7.3	7.5
Hydroxy benzoic acids	< 0.1	0.3	0.3	0.5
Flavanols	0.6	20.5	14.0	13.9
Proanthocyanidins	1.3	37.2	27.3	32.4
Quercetin flavonoids	2.0	19.3	20.8	27.9
Kaempferol flavonoids	0.8	12.5	8.4	12.0
Other flavonoids	< 0.1	0.2	0.1	0.1
Sum	6.3	108.6	83.5	107.3

## Results and discussion

The HPLC chromatograms (recorded at 265 nm) show the hop polyphenols in the beers. To allow an easy comparison the input of the polyphenols from malt is subtracted:



The relations between the dosage of hop polyphenols and the recovery in the beers ( in % ):



Hop polyphenols behave differently during the brewing process. Some compounds can be found in the beer quantitatively. On the other side some substance groups were reduced significantly.

Additionally some peaks were found to be unique for a variety. Especially from Hersbruck and Tett nang hops some of such compounds were detectable also in the beers.

## Conclusion

Differences in the contents and the composition of the polyphenols in hop varieties are shown. Also their influence to the related beers is demonstrated.

The single compounds behave differently. The recovery of catechin and epicatechin lies over the average whereas procyanidins yield considerably less. Kaempferol-3-glucoside and one of the caffeoyl quinic acids are found completely in the beers. The results show that both, hopping rate and variety, influence the content and the composition of low molecular polyphenols in beer considerably.