

Descriptive sensory analysis of the odour character of hop essential oils

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Introduction

Hops give beer their unique flavour. There are many different varieties of hops, each with a unique sensory character. The development of a standardised sensory vocabulary describing these sensory qualities would make it possible to compare studies across time and location. To date little research has been conducted on the sensory aspects of hop essential oils.

The aims of this study were:

To develop a sensory vocabulary to describe the odour of hop essential oils. To use this vocabulary to identify similarities and differences between hop essential oils with respect to their odour character.

Hop Essential Oil Samples

Twenty-nine hop essential oil varieties were evaluated during this study (Table 1).

These represented different geographic locations, year of extraction, and extraction techniques, although variation in these variables was not controlled by an experimental design.

Sensory Analysis

A trained panel of ten panellists assessed the hop essential oils using standard sensory descriptive analysis techniques. Hop essential oils were evaluated in duplicate.

Sensory evaluation was also performed by an advisory panel consisting of ten people representing brewing and hops industry and academia. Data were analysed using Principal Components Analysis (PCA).

Results

The trained sensory panel generated a vocabulary consisting of 17 terms, complete with definitions and reference standards.

Differences and similarities between the hop essential oils' sensory characteristics were uncovered through PCA (Figures 1 and 2).

The sensory attributes that were most important in discriminating between the 29 hop essential oils were pipfruit and aromatic/woody.

Majority of the variation between the hop essential oils was explained by PC 1. Hop essential oils that were high in pipfruit and fresh vegetative, such as 'Pacific Jade' and 'Pacific Hallertauer' were grouped.

They differed from those that were high in aromatic/woody, earthy or spicy, such as 'Hallertau Hallertau' and 'Fuggles'.

The second principal component identified hop essential oils that were strong in tropical fruit and floral, such as 'Topaz' and 'Millennium'. They differed from those that were high in phenolic notes, such as 'Nelson Sauvin', 'First Gold' and 'Cluster'.

New Zealand grown varieties, such as 'Southern Cross' and 'Green Bullet', were characterised by pipfruit and fresh vegetative notes. Conversely, European oils, such as 'Strisselspalt' and 'Styrian Golding', were higher in levels of in aromatic/woody, ginger and spicy notes.

The vocabulary developed by the advisory panel was very similar to that of the trained panel, adding validity to the trained panel results.

Conclusion

An objective sensory vocabulary for hop essential oil odour was developed.

This vocabulary was successful at describing the odour characteristics of hop essential oils, and discriminating between hop essential oils in terms of these odour characteristics.

The standardised vocabulary can be applied in an industry setting for the quality control of hops, shelf-life testing of hops and beer, and the production of new beers tailored to consumer demands, or by other research institutions, allowing different studies to be compared on an equal basis.

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Table 1. Odour characteristics for hop essential oil varieties

Country of origin	Hop oil variety	Distinguishing odour characters
New Zealand	'Pacific Hallertauer'	Pipfruit, fresh vegetative, gin
New Zealand	'Belgium Saaz'	Citrus fruit, fresh vegetative, herbaceous
New Zealand	'Pacific Jade'	Pipfruit, coconut, fresh vegetative
New Zealand	'NZ Hallertauer'	Citrus fruit, pipfruit, fresh vegetative
New Zealand	'Nelson Sauvin'	Pipfruit, phenolic
New Zealand	'Southern Cross'	Citrus fruit, pipfruit, fresh vegetative
New Zealand	'Green Bullet'	Fermented fruit, fresh vegetative, phenolic
New Zealand	'Pacific Gem'	Citrus fruit, pipfruit
New Zealand	'Super Alpha'	Pipfruit, phenolic
Australia	'Topaz'	Tropical fruit, floral
USA	'Cluster'	Phenolic
USA	'Cascade'	Ginger, floral, aromatic/woody
USA	'Millennium'	Tropical fruit, floral
USA	'Columbus'	Tropical fruit, fermented fruit
USA	'Galena'	Citrus fruit, coconut, fresh vegetative
United Kingdom	'Fuggles'	Spicy, resin, aromatic/woody, earthy, sweaty
United Kingdom	'Goldings'	Ginger, aromatic/woody
United Kingdom	'Northdown'	Spicy, ginger, resin, aromatic/woody, earthy, sweaty
United Kingdom	'First Gold'	Spicy, phenolic
United Kingdom	'Challenger'	Herbaceous, earthy
United Kingdom	'Target'	Herbaceous, spicy, ginger, resin, aromatic/woody
United Kingdom	'Progress'	Herbaceous, spicy, earthy
United Kingdom	'Admiral'	Tropical fruit
Germany	'Hallertau Hallertau'	Herbaceous, spicy, resin, aromatic/woody, earthy
Germany	'Perle'	Citrus fruit, ginger
Germany	'Hallertau Hersbrucker'	Spicy, ginger, aromatic/woody, earthy, sweaty
France	'Strisselspalt'	Spicy, ginger, aromatic/woody, earthy
Czech Republic	'Saaz'	Citrus fruit, spicy, ginger
Slovenia	'Styrian Golding'	Citrus fruit, spicy, ginger

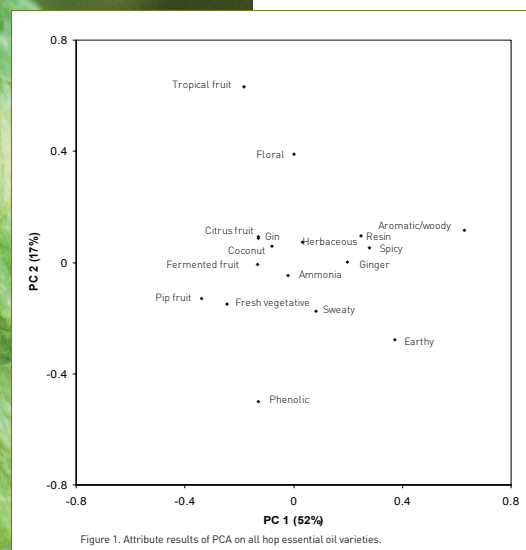


Figure 1. Attribute results of PCA on all hop essential oil varieties.

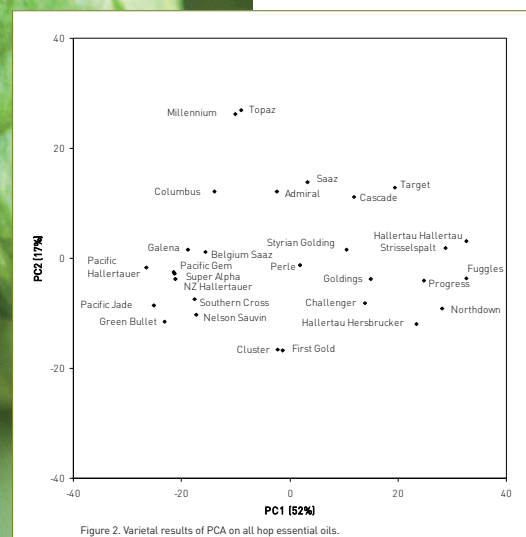


Figure 2. Varietal results of PCA on all hop essential oils.