Emulsifying Hop Oils with A Hop-Derived Ingredient

A-27

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2022 ASBC Meeting
BREWING SUMMIT 2022
Providence, Rhode Island | August 14–16

INTRODUCTION

Addition of hop oils and hop oil fractions to beers and other beverages provides possibilities for creative flavour enhancement and experimentation. It also offers brewers significant gains in efficiency compared to classic aroma hop additions. Since the flavour-active components of hop oil are typically non-polar or weakly polar, carriers such as propylene glycol or ethanol, or emulsifiers are used. Increasingly, brewers are concerned about these non-beer natural or extrinsic components due to labelling issues and a general desire for natural products. We have found that hop acids can be used to emulsify hop oil fractions in aqueous carrier, creating a 100% hop-derived product.
In this work, we compare this new formulation to a traditional product using PG as a carrier. Sample data is presented for a low-terpene hop oil fraction.

STABILITY TESTING

Stability of the hop-acid-based hop oil emulsion was assessed using two methods, a simple laboratory centrifuge and a more sophisticated LUMiSizer® analytical centrifuge.

In the laboratory test, the emulsion was centrifuged at 5000 rpm for 2 ½ minutes and apparent absorbance before and after centrifuging was measured at 950 nm against a water blank using a spectrophotometer. A separation of the emulsion or creaming would lead to a reduction in absorbance. Earlier experiments suggested that an absolute value of less than 10 for ΔOD950 (i.e. ΔOD950 values between 0 and -10%) indicates a potentially stable emulsion.

Emulsion samples were also sent to Adaptive Instruments Ltd. for analysis with a LUMiSizer® 651 instrument, which measures light (NIR) absorption and scattering along the length of the sample during centrifugation. This provides time and space resolved information on changes in particle distribution. Creaming or cracking of the emulsion leads to a shift in the transmission profile.
Transmission profiles were collected over approx. 8 hours in 5 and then 30 second intervals to simulate two-year storage at 1g.

RESULTS

In the laboratory test, the formulation consistently showed ΔOD950 values in the region of 1-2 % (see Table 1), indicating a stable emulsion.

Table 1. Changes in absorbance for a hop-acid based hop oil emulsion before and after centrifugation.

	OD_{950} before spinning	OD_{950} after spinning	ΔOD_{950}
Mean value	0.384±0.004	0.379±0.002	-1.3±0.6 %

These results were confirmed by the LUMiSizer®, which showed very consistent transmission profiles and thus a high predicted emulsion stability over 2 years (see Figure 1).

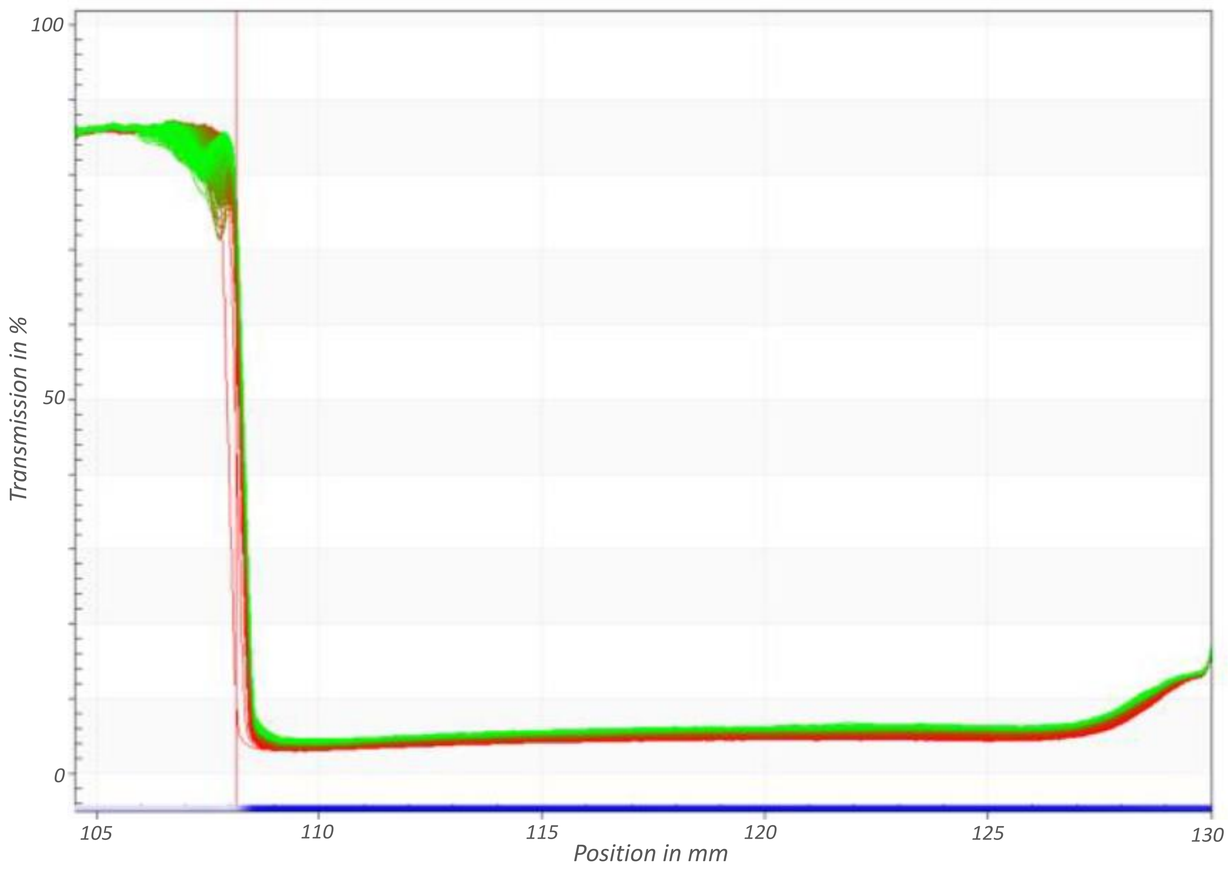

Figure 1. Transmission profiles over time for the hop-acid based emulsion. The first profiles obtained are marked red, the last green. 1000 profiles ≙ 2 years @1g.

COMPARISON IN BEER

Both a PG- and the hop-based hop oil formulations using the same low terpene oil fraction were dosed into a commercial lager beer to compare their performance. Beers were dosed at 10 ml/ hl to be analysed for EBC haze and by SPME-GC-MS to estimate oil incorporation. For sensory analysis using the BarthHaas Hopsessed® scheme, beers were dosed at 40 ml/ hl.

RESULTS

No difference was detected between the two formulations for haze formation in beer (see Table 2).

Table 2. EBC haze at 4 °C for lager beers dosed with PG- and hop acid-based hop oil formulations.

	PG formulation	Hop acid formulation
Mean value	0.37±0.03	0.38±0.04

The hop oil incorporation measurements using SPME-GC-MS showed that transfer of the key aroma compounds into beer was similar (>85%) between the PG and hop acid-based formulations for most compounds and even higher for the terpene alcohols (see Figure 2).
This was confirmed in the sensory analysis where no significant difference could be detected between the two formulations (see Figure 3).

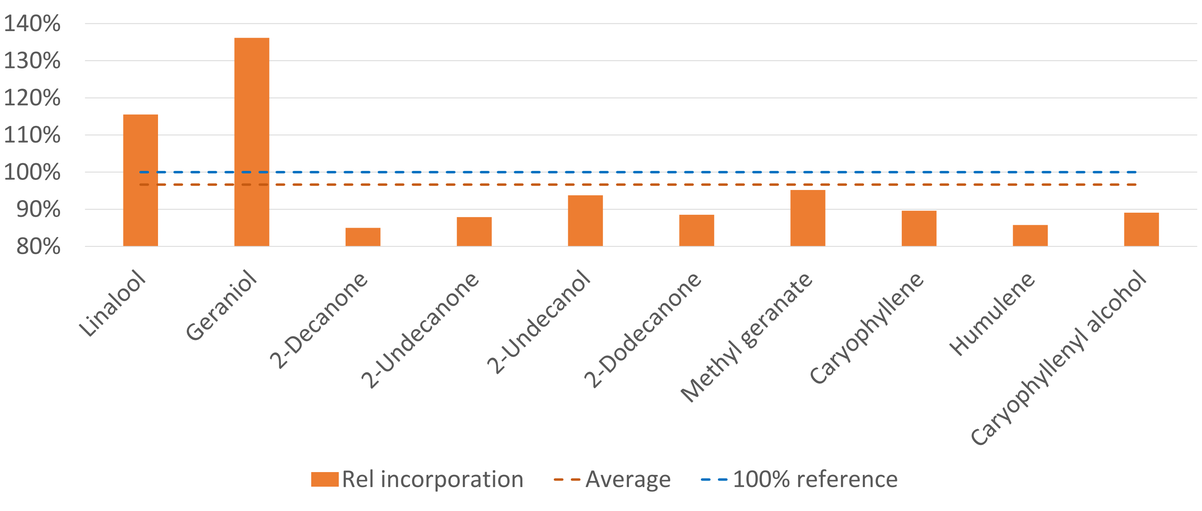

Figure 2. Relative incorporation of key aroma compounds into lager beer when using the hop acid-based formulation compared to the PG reference product.

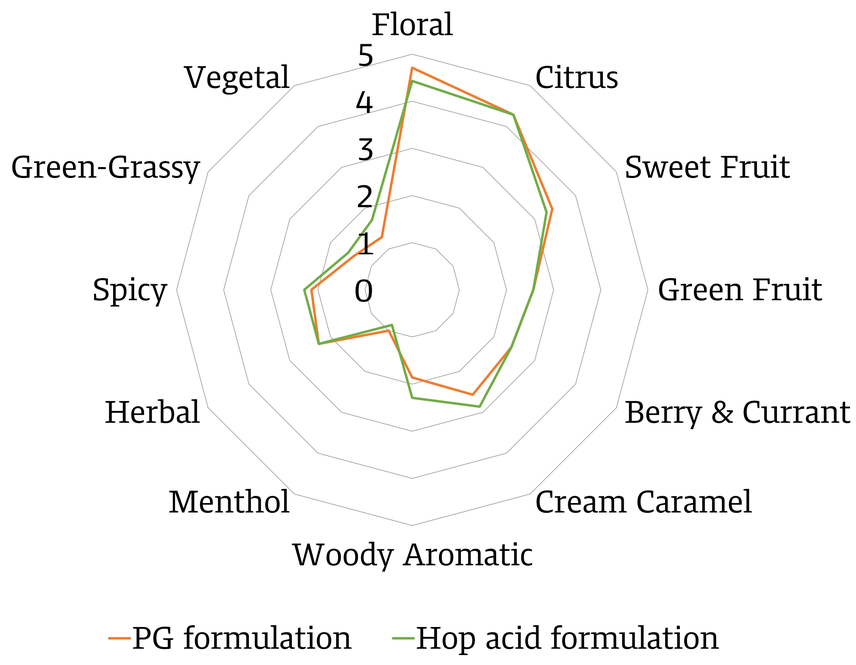

Figure 3. Sensory profiles of lager beers lager beers dosed with PG- and hop acid-based hop oil formulations.

CONCLUSION

Analysis of this novel formulation shows high stability of the emulsion. Dosing trials into lager beer show a comparable impact to traditional PG-based formulations on flavour, aroma and haze, allowing brewers to modulate their beer flavour and aroma without using non-beer natural or extrinsic components.