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Dry Hopping with a flowable hop extract

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INTRODUCTION

The most important hop product for dry hopping are hop pellets. They are used either in a static or a dynamic application in dry hopping. Dry hopping causes considerable beer losses which are accepted by the brewers due to characteristic and intense hop flavors. In this work traditional dry hopping practices were compared with using a flowable hop extract instead. Dry hopping for all trials was carried out during lagering. In this work various parameters were analysed, including filterability by means of the Esser-test, bitter substance content by HPLC, aroma components by HS-SPME-GC-MS/MS and foam values using the NIBEM measuring device. Also a sensory evaluation was carried out using the Hopsessed® scheme, developed by BarthHaas. Only the results in terms of beer losses and influences on bitterness are presented on the following poster. Specifically in regard to bitterness the benefit was that the use of the product did only slightly influence sensory bitterness since the product does not contain Humulinones.
To investigate beer losses associated with dry hopping swelling tests were carried out with the hop varieties Citra® HBC 394 c.v., Callista and Monroe. The resulting numbers indicate a considerable amount of beer losses for traditional dry hopping methods. These beer losses can almost completely be avoided with the use of the newly developed hop extract, as the product is fully dispersible in water or beer and no beer loss is observed. The experiment on losses were carried out with water.

TRIAL SETUP – BEER LOSSES

For these experiments, approx. 3 g of the respective hops were weighed out in the Erlenmeyer flask and 200 ml of water was added. The weighing-in was done using an analytical balance, model BTG-303, from Phoenix Instruments, Garbsen, Germany. The suspension was then placed on a magnetic stirrer with stirring fish for 60 min and the rotational speed was set to 200 rpm. The filled Erlenmeyer flask was sealed with aluminium foil. In the meantime, approx. 750 ml of water was placed in an Imhoff funnel from VITLAB GmbH, Grossostheim, Germany. After the dispersion time had finished, the hop slurry water mixture was transferred into the Imhoff funnel and filled up to 1 l with water. The set-up was then covered with aluminium foil as shown in Figure 1. From this point on, the respective hop slurry water mixutre was no longer moved and the mixture was given two hours to sediment. Bandelt Riess et al. were able to show that after a swelling time of two hours no change could be detected in hop pellets [1]. After this time, the respective volume of the swollen hop pellets could be read off by means of the attached scale (see Figure 2). This procedure was carried out four times for each variety. In order to be able to assess the actual increase in volume, the bulk density of the respective hop pellets was finally determined three times by means of a modified analysis for the hectolitre weight according to MEBAK raw materials, 2006, chap. 1.3.3. The measuring container of the Reichsgetreidewaage has a volume of 250 ml. Using formula 1, the bulk density could be determined from the values obtained.

Formula (1) Bulk density [g/l] = Weight [g/0,25 l] × 4

Figure 1: Trial set-up beer losses

Figure 2: Volume after swelling

ANALYTICAL RESULTS – BEER LOSSES

Table 1: Results beer losses of four different hop varieties and processing forms

Hop Variety - Product	Volume After Swelling [ml]	Increased In Volume [%]	Theoretical Loss Through 1 kg Hop Product [l]
Citra HBC 394 c.v. - T90	42.00 ± 1.83	670	14.13
Callista - T90	39.25 ± 1.50	692	12.81
Callista - T45	31.50 ± 2.65	521	10.28
Monroe - T45	32.75 ± 1.26	557	10.80

ANALYTICAL METHODS – BITTERNESS

Within the scope of this work, the content of various hop bitters in beer was investigated. The substances investigated were iso-alpha-acid, Humulinones and alpha-acid. The total content was determined in each case by means of HPLC. These analyses were carried out externally by Barth Innovations Ltd, Paddock Wood, United Kingdom. The measurements were carried out in triplicate for each treatment method and batch. One base beer was brewed for each trial series and split into 4 different CCTs for further dry hop treatment.
The results are shown in Table 2 and Figure 3.
The calculated bitterness was calculated according to formula 2 [2]:

Formula (2) Calculated Bitterness = c[Iso-Alpha-Acids] + 0,66 × c[Humuliones]

ANALYTICAL RESULTS - BITTERSNESS

Table 2: Content of various bittering substances

Dosing Application	Humulinones [mg/l]	Iso-alpha acids [mg/l]	Alpha-acids [mg/l]	Calculated Bitterness [mg/l]
Reference beer/without	0.40 ± 0.01	20.93 ± 0.40	3.33 ± 0.06	21.20 ± 0.04
Flowable extract	0.77 ± 0.06	21.07± 0.32	7.50 ± 0.01	21.57 ± 0.36
Dynamic	3.52 ± 0.12	19.00 ± 0.35	6.33 ± 0.23	21.33 ± 0.42
Static	3.49 ± 0.10	20.47 ± 0.06	6.70 ± 0.17	23.43 ± 0.12

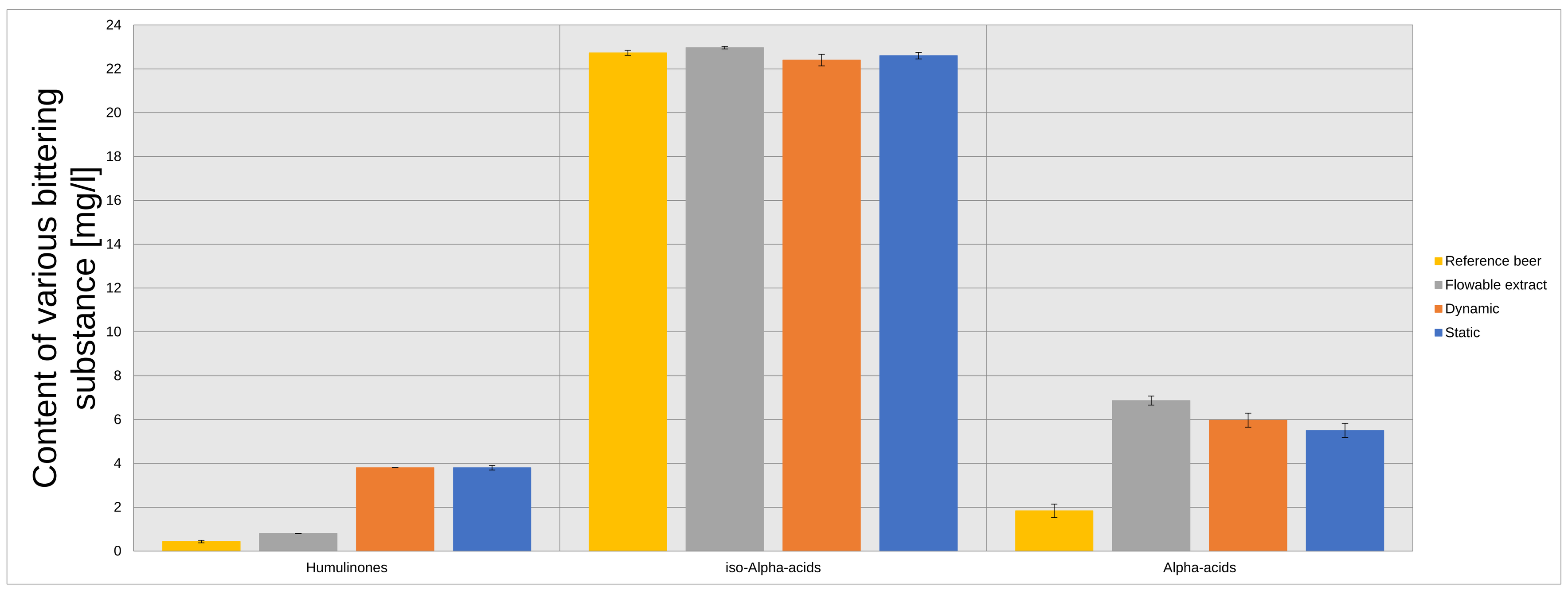

Figure 3: Content of various bittering substances

Table 3: Applied hop products for dry hopping for every treatment

Hop Product	Alpha-acid content [%]	Oil content [ml/100g]
T90 Citra® HBC 394 c.v.	11.02	2.10
Flowable extract	12.24	7.49

CONCLUSION

It could be shown that losses of 10.80 – 14.13 l per kg of hops are to be expected from the hops while dry hopping, depending on the variety. In comparison, there was no beer loss when using the flowable extract, as the extract was almost completely dissolved in cold and warm condition. In the comparison between Callista T45 and T90, it became apparent that vegetative leaf material was separated by the separation process in the production of enriched pellets. At the same time, this resulted in a proportionate increase in the lupulin content. This explains the lower swelling capacity of the enriched T45 pellets compared to the normal T90 pellets.
When looking at the iso-alpha acid concentrations in the four different beers, no significant differences were found. In addition, no loss of iso-alpha-acid could be determined by the different dry hopping treatments, including the flowable extract one. It has already been shown in various publications [3,4] that the use of hops in cold condition can lead to additional precipitation of iso-alpha acid. The iso-alpha acid accumulates on the surface of the green material and is then excreted via the trub. This losses can be prevented by applying the flowable extract, due to the fact, that it does not contain any green material. The slightly higher alpha-acid content in the extract beer compared to the other two treated beers can be attributed to the higher initial content in the extract (see Table 3). In addition, it could be shown that the dry hopping method with the flowable extract only slightly increased the concentration of Humulinones compared to dynamic and static treatments. Thus, no change in sensory bitterness had occurred through the application of flowable extract.
The various trials which has been carried out in terms of process technology and analysis proved the extracts suitability for the brewing process. Especially in terms of beer losses, the extract can show its high potential as an alternative to the classic dry hopping treatments.

LITERATURE

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