CONES OR PELLETS?

Vakupack: Whole hops packed under inert atmosphere

The hops' most valuable ingredients for beer are: bitter compounds, aroma components and polyphenols. All of these ingredients are prone to oxidation. For instance, alpha acid values decrease by 15 to 30 percent (depending on the hop variety) within one year even when stored in cool places at 0 – 5 °C. [1] The hops are delivered by the farmers in rectangular bales. These bales can be stored in cool warehouses for one year at most. Consequently, stockpiling for several years is not possible. Therefore, it is crucial to eliminate oxygen in order to make hops durable.

The most common way to preserve hops is to pelletize them and pack the pellets into diffusion-resistant aluminum laminated foils. Pellets offer the following advantages:

– Pellets can be stored for several years at 0 to 5 °C as they do not get in contact with oxygen. [2]
– Pellets are pourable and can be dosed automatically in a brew house.
– It is easy to separate the pellet trub together with the hot break in the whirlpool.

Some brewers (especially in small and/or craft breweries) have prejudices against pellets:

Figure 1: 5 kg of loose hops and a 5 kg Vakupack (with and without foil)

Figure 2: A press compresses the loose hops into rectangular packets.

– Pellets do not have the hop cones' natural structure and look like "animal feed."
– During pelletizing, the hop powder is exposed to temperatures of 50 – 60 °C. This could harm some sensitive substances.

This creates the following task: The hop cone's natural structure is to be retained by using a packaging which prevents oxidation.

Solution

Whole hops have been packed into durable "Vakupacks" under inert atmosphere for a considerable time now. The first production steps are similar to pelletizing: Stems, leaves, heavy materials and metals are

separated from the hops. If necessary, the hops are dried to 8 – 10 percent water content. Unlike pellets, the whole hops are then weighed into units of 4 – 5 kg and compressed from 100 kg/m³ to 500 kg/m³ into rectangular packages by means of a robust press. Those packages are then wrapped into oxygen-tight foils. Air is detracted from the packages in a vacuum chamber and the foils are welded. Finally, the foils are packed into cartons.

Negative aspects of whole hops in Vakupacks

– In order to maintain the cone's structure only very gentle conveyors must be used (e.g. no screws).

– Hop cones crumble easily, therefore, mixing and homogenizing is not possible (unlike powder). In consequence, the homogeneity is inferior compared to pellets.

– It is difficult to weigh flexible portions. It is not possible to pack according to the alpha acid content.

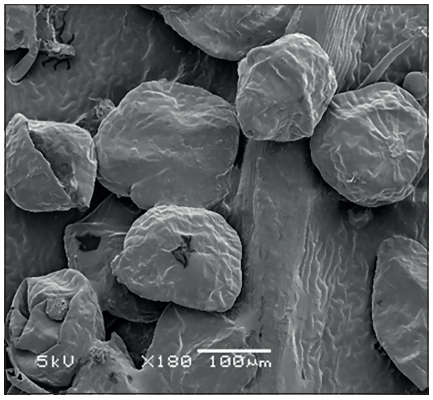

Figure 3: Intact lupulin glands in farmer bales

– Dosing in the brew house is more complicated.

– Brewers need additional equipment to separate the cones from wort and beer (e.g. a hop strainer, hop back, a filter or a centrifuge).

– Wort losses are therefore higher (approx. twice as high as when using pellets).

– More staff is required to produce Vakupacks because production can hardly be automated. Therefore, production costs are higher compared to pellets.

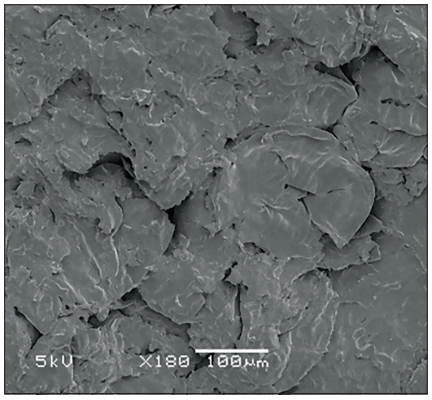

Figure 4 shows squeezed lupulin glands in Vakupacks.

Positive aspects of whole hops in Vakupacks

– During the pressing process, the lupulin glands are being squeezed (similar to pelletizing). This can improve the transfer of aroma compounds especially during dry hopping (see later).

– The whole process takes place without any increase in the hops' temperature.

– Only seconds pass between the pressing process and inert packing.

Table 1: Key product data (Series 1 / Series 2)

Table 1: Series 1/Series 2		WH	VP	PE
α-acids EBC 7.7	% w/w	2.5/5.4	2.5/5.2	2.4/5.1
β-acids EBC 7.7	% w/w	3.7/4.3	3.9/4.5	3.9/4.7
Hop Storage Index	EBC 7.13	0.34/0.35	0.34/0.36	0.35/0.38
Hop oil EBC 7.10	ml/100 g	0.55/1.0	0.50/0.95	0.50/0.95

– In consequence, there are no analytical differences between whole hops in bales and Vakupacks due to the gentle processing method.

Brewing trials

Two test series (crop years 2014 and 2016, variety: Spalter Select) were conducted in the research brewery (2 hl, Hopfenveredlung St. Johann). Whole hops (WH), Vakupacks (VP) and Pellets Type 90 (PE) were used. Table 1 shows key data from both series. The first figures refer to crop 2014, the second to 2016. Differences between the crop years are mainly influenced by different weather conditions. But there are no significant differences between WH, VP and PE. However, the Hop Storage Index (an aging index according to ASBC) is slightly higher for pellets.

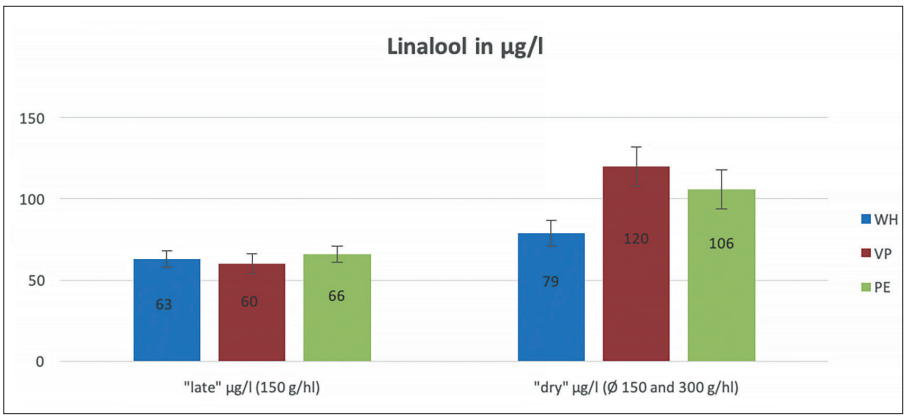

Figure. 5: Average linalool values (series 1)

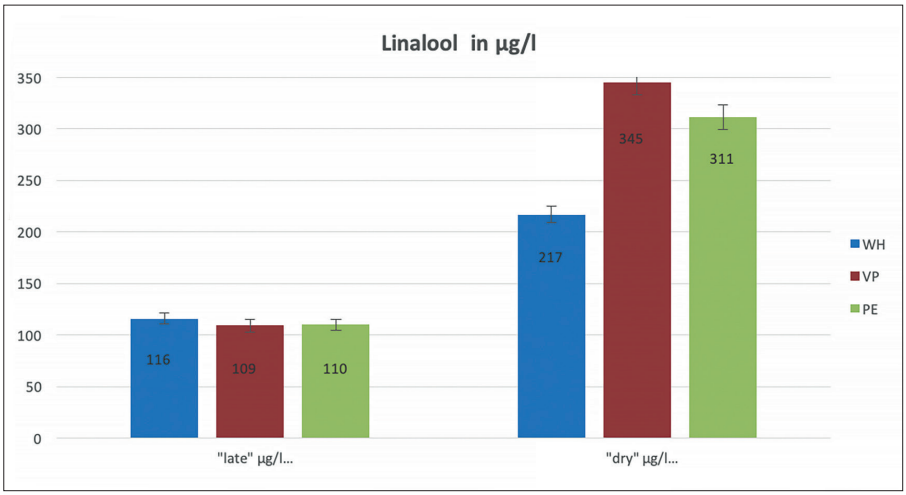

Figure 6: Comparison of linalool values (series 2)

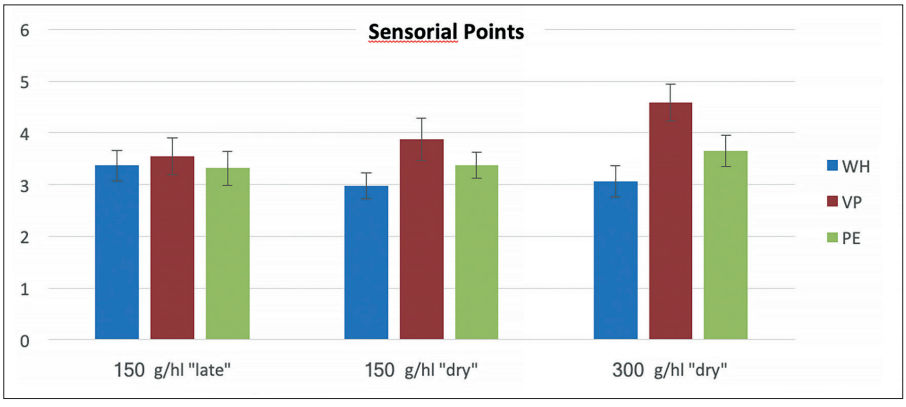

Figure 7: Sensory evaluation of beers according to internal scheme (series 1)

Lager beers were hopped in the following ways:

– Hopping at beginning of boiling with 8 g alpha acid/hl from a Taurus CO_2 extract (poor in hop oil).
– The three products (WH, VP and PE) were dosed at end of boiling with 150 g/hl each.
– Dry hopping with 150 (only series 1)/300 g/hl each (WH, VP and PE).

Analytical results of beers

In both series, bitterness units varied between 19 and 22 IBU and iso-α-acids between 17.7 and 19.2 mg/l. This means both values only varied within the analytical tolerance limits. There was also no difference in the polyphenol contents of the three beers.

Linalool is a very interesting indicator for hop aroma in beer. [1, 3] The values of late hopped beers and the averages of dry hopped beers (150 and 300 g/hl) of series 1 are shown in figure 5. The late hopped beers do not show any differences in linalool (considering analytical accuracy). When it comes to dry hopped beers, VP and PE show significantly higher results. Figure 6 illustrates the linalool values of series 2. Late hopped beers show no differences, in contrast to dry hopped beers.

Beers that were dry hopped with 300 g/hl show significant differences. Beers brewed with VP and beers brewed with PE were 60 percent, respectively 44 percent higher in linalool than beers made from whole hops. The intact lupulin membrane does not delay the aroma transfer during late hopping as the lupulin gland bursts immediately in the hot wort. However, during dry hopping it plays a major role despite the fact that the con-

tact time of seven days at 14 °C and two weeks at 0 °C is comparatively long. Other studies also show that an intact lupulin gland makes it harder to transfer aroma substances. [4] Vakupacks are just as efficient as pellets, maybe even better.

Sensory results of beers

Series 1: Preference according to DLG (Deutsche Landwirtschafts-Gesellschaft):

150 g/hl "late": No difference

150 g/hl "dry": VP slightly better than WH and PE

300 g/hl "dry": VP significantly better than WH and PE

The beers were rated according to the CMA (Centrale Marketing-Gesellschaft der deutschen Agrarwirtschaft), a specific ranking system for hoppy beers. Figure 7 shows the average points of five aroma descriptors (hoppy, fruity, citrussy, floral and herbal).

There are no differences in late hopped beers. When looking at the beers dry hopped esp. with 300 g/hl the sensorial intensity of PE and especially of VP beers is significantly more pronounced which corresponds to the linalool results. In a tasting of late hopped and dry hopped beers, a consumer panel of 25 people preferred VP beers over PE beers in both dry hopped categories (150 and 300 g/hl). They did not note any difference in the late hopped beers.

The results of series 2 were similar. With regard to late hopped beers, VP and WH beers were preferred over PE beers (according to DLG). The CMA test showed results that were very similar to series 1: PE and especially VP beers have a much higher aroma potential. The consumer panel preferred VP beers over WH and PE beers in both categories (late and dry hopped).

Conclusion

Vakupacks combine the advantages of whole hops ("naturalness" and no increase in temperature during processing) with the oxidation protection also offered by the pellet packaging. The cone's structure is maintained despite a compression to 500 kg/m³. Dry hopping benefits from the squeezed lupulin glands. This increases the transfer rate of aroma substances during dry hopping by approximately 50 percent as shown for linalool.

Beer made with Vakupack hops achieves better sensorial results than beer made from whole hops because of a more intense aroma. The Vakupack beer is as good as beer made from pellets or even better.

Although Vakupacks are not easy to handle, many brewers who like whole hops use Vakupacks in order to stand out against bigger breweries. Vakupacks offer a consistent quality over several years. □

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