

Akoya – a response to climate change?

NEW HOP VARIETY | Pearls have fascinated mankind for 5000 years. Their lustrous and elegant sheen makes the Akoya pearl very special, it is a synonym for quality but also for the achievements of modern breeding. Like the pearl breeders in Japan, the Hopsteiner hop breeders devoted much time and energy to developing their very own pearl. The outcome: Akoya.

FOR SEVEN YEARS, the research group led by agronomist Dr. Alexander Feiner has cultivated and tested breeding strain 99/268. It was decided in the autumn of 2019 to officially declare the plant as being a new variety. The hop breeders were absolutely convinced that Akoya, in view of its stable yield and its robustness, will cope well with the climate change and, thus, provide growers and brewers with a new perspective.

In an interview with BRAUWELT International, Dr. Alexander Feiner revealed important details about Akoya.

A new hop variety withstanding climate change. This sounds exciting. Which attributes does such a variety require?

Dr. Alexander Feiner: The climate change is a fact that we can no longer ig-

nore in Germany. Climate scientists tell us that, in decades to come, we have to expect rising temperatures, different rain patterns, and it will become increasingly more difficult to ensure water supplies needed by agriculture. In addition to new solutions to ensure water supply, we need plants that adapt to these changes and make do with the resources available. The Akoya hop plant that we bred is eminently comparable to the known Perle variety though it is better suited to withstand current weather conditions. We approached our research in striving for a new variety in the traditional aroma sector that offers a consistently higher yield and, at the same time, a com-

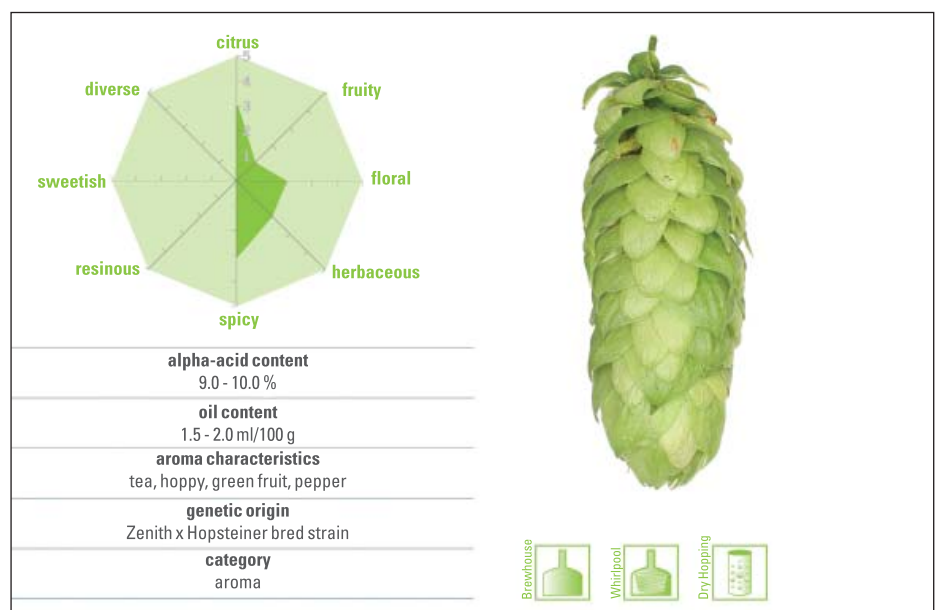
parable aroma profile. And that is exactly what we achieved in cultivation and brewing tests. It is not just a coincidence that we managed to develop a high-quality new variety. The outcome reflects a carefully considered, continuous team effort. We have focussed at all times on our major objective in developing Akoya.

How did you choose this exotically sounding name?

Dr. Feiner: That's a wonderful story. Following the good results in cultivation and in beer, we were ultimately in need of a succinct name for the bred strain. We asked all colleagues working at Hopsteiner about how they would name the new breed. We received more than 100 feedbacks. Finally, one of our apprentices had the compelling idea: Akoya. We were all excited by the suggestion because Akoya is the name of the best known pearl breed worldwide and is a very good synonym for our own "hop pearl". And we adopted this name for the new breed.



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Have hop growers already reacted? And what do brewers think?

Dr. Feiner: They are excited. In 2019, shortly before harvest, we organised a one-day event on location where Akoya is grown to familiarise more than 250 hop farmers with the new variety. There was a huge interest in Akoya. Many wanted to sign a cultivation contract on that very same day. The story of a new breed ensuring a consistent and reliable yield in the future was a complete success. We therefore expanded the acreage in 2020. This step provides us with higher quantities for brewing tests and we can actively sell the new variety. During initial distribution, we will have the highest number of growers possible on board so that proliferation of Akoya can rise exponentially, if possible, in operations in years to come and an adequate expansion of acreage is ensured.

The Hopsteiner breeding program

At the end of the 1990's, the breeding program of the Steiner Group was established in the United States in order to develop resistant high-alpha varieties with a secured yield for the market of the time. In a consistent step, the research program in Mainburg was extended in 2012 in order to systematically breed high-performance varieties for

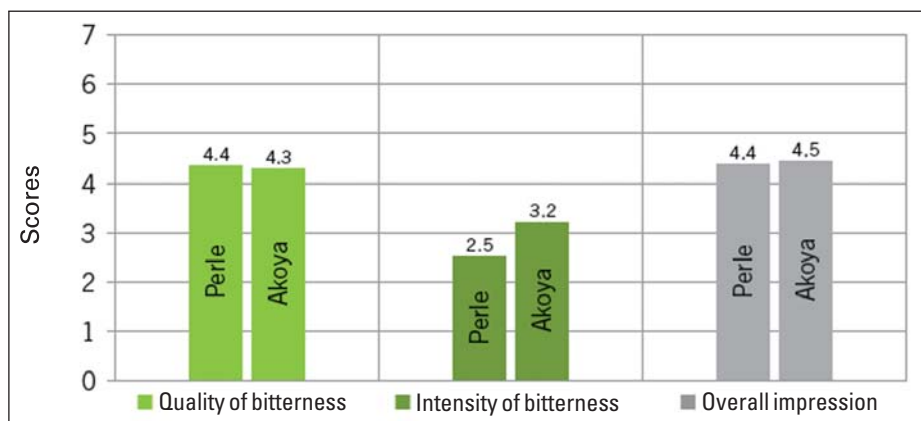


Fig. 2 Quality of bitterness, bitterness intensity and overall impression of tasted beers

European hop cultivation. It generally takes about 10 years to develop a new hop variety. Hence, together with various cooperation partners, we have been very committed at our German facility to research the topic of breeding in order to be able to market new varieties in due course.

Using up-to-date breeding methods

All challenges facing modern hop breeding can nowadays be overcome by employing up-to-date breeding methods. American and German scientists at Hopsteiner avail, for example, of molecular genetics to investigate particular characteristics in the hop genome. They can thus recognise DNA fragments associated with a definite characteristic [1]. It has thus become possible to select new crossing partners and their progenies at a very early stage. This method accelerates the very time-intensive breeding work as it can be assessed prior to planting in the field whether or not a plant possesses the required attribute, such as e.g. resistance to mildew.

Profile of Akoya

The robust English Zenith variety was used as the female cross partner. The important breeding progress, however, was made in selecting the suitable male partner originating from the Hopsteiner breeding program. The selection of Akoya proceeded as follows:

- 2012: crossing the parents selected and recovery of the seeds;
- 2013: germination of seeds and rearing the seedlings in the breeding yard;
- 2016: selection of the genotype within the crossed family based on the most positive attributes, and escalation to multi-plant tests as well as serial trials at several

locations;

- 2017: escalation of the bred strain to large-area tests;
- 2019: variety application with the Community Plant Variety Office and variety denomination.

In view of the early ripening and harvesting time and during the selection years, the bred strain turned out to be a suitable replacement for the established aroma varieties (Perle or Hallertauer Tradition) in German hop cultivation. Calculated and measured yields in past harvesting years would indicate an average yield of about 2400 kg/ha. This needs to be confirmed in years to come.

Due to good resistances against diseases such as downy and powdery mildew as well as verticillium wilt and drought stress, Akoya yielded consistent alpha-values of about 9-11 percent and oil contents of about 1.5-2.0 ml/100 g. The aroma of the raw hops can be described as reminiscent of herbs and tea as well as slightly fruity including notes of mint and pepper. Table 1 lists the mean analytical values from the various test stages in harvest years 2016 to 2019.

In view of higher levels of humulene and β-caryophyllene, composition of the main oil components of Akoya is comparable to the values found in the Perle variety. They impart, among other impressions, a raw hop aroma reminiscent of herbs and hops. In assessments from the 2018 and 2019 harvesting years by various brewers in Mainburg, Akoya was perceived as aroma-active resulting from higher oil and linalool levels. However, aroma characteristics were classified as similar to Perle or Hallertauer Tradition. Fig. 1 summarises the profile of the Akoya variety.

MEAN ANALYSIS DATA OF AKOYA ...	
... from 2016 to 2019	
KW EBC 7.4	10.0%
tot. α-acids *	9.5%
% rel. cohumulone	30.0
tot. β-acids *	5.0%
% rel. colupulone	60.0
xanthohumol **	1.0%
tot. resin EBC 7.5	24.0%
% rel. hard resin EBC 7.5	13.5%
tot. oil EBC 7.10	1.7 ml / 100g
% rel. myrcene***	43.0
% rel. linalool***	0.7
% rel. caryophyllene***	12.0
% rel. farnesene***	n.d.
% rel. humulene***	32.0

Table 1
n.d.: not detectable
*Method: HPLC EBC 7.7/ICE
**Method HPLC EBC 7.15/ICS-X1
***Method EBC 7.12

ANALYSIS DATA OF HOPS USED IN THE BREWING TEST

Variety	KW(EBC 7.5) %	Alpha-acids (EBC 7.7)	Co-humulone % rel	Beta-acids (EBC 7.7) %	Co-lupulone % rel
Perle	8.7	7.3	30.0	4.7	54.2
Akoya	9.5	8.1	29.7	3.9	58.5

Table 2

ANALYSIS DATA OF BEERS TESTED

Variety	BU (EBC 9.8)	Iso- α -acids*mg/l	Alpha-acids* mg/l	Linalool** μ g/l
Perle	21.8	22.6	3.3	7.7
Akoya	22.5	23.9	4.3	32.2

Table 3

*in-house method, HPLC; **EBC 9.49

ANALYSES OF HOP AROMA COMPOUNDS OF BEERS TESTED

	Perle	Akoya
	μ g/L	
Ethyl-2-methylbutanoate	n.d.	n.d.
Isoamyl acetate	1272	1632
Isobutyl isobutyrate	<5	<5
Myrcene	n.d.	9.8
beta-limonene	n.d.	n.d.
3-methylbutyl isobutyrate	n.d.	n.d.
2-methylbutyl isobutyrate	<5	<5
2-nonanone	n.d.	n.d.
Linalool	7.7	32.2
2-decanone	n.d.	n.d.
Methyl nonanoate	n.d.	n.d.
Terpineol	<5	<5
Citronellol	n.d.	n.d.
Geraniol	n.d.	n.d.
2-undecanone	n.d.	n.d.
beta-Caryophyllene	n.d.	n.d.
Farnesene	n.d.	n.d.
2-dodecanone	n.d.	n.d.
Humulene	<5	<5
Ethyl dodecanoate	73.1	119.9

Table 4

Tasting results at BrauBeviale

Following years of selection, development, yield measurements and testing for resistances, visitors were able to taste the new variety in Nuremberg at BrauBeviale 2018. The interesting question was posed: would the new Akoya variety, at that time

still known under its technical designation 99/268, be convincing when tasted in a beer?

Two identical beers were brewed to make a sensory comparison between the existing Perle variety and Akoya. One was hopped exclusively with Perle and the other exclusively with the new Akoya variety. Pellets

P90 having an approximately comparable alpha-acid content were selected. Table 2 lists the analysis values of both varieties.

A total of 312 tasters assessed a “Bayerisches Helles” (Bavarian Pale Ale) (original gravity 11.5 °P, alcohol content 4.3 percent by volume) brewed with three hop additions in the form of pellets: 50 percent at the start of boiling, 25 percent after twenty minutes and 25 percent twenty minutes before the end of boiling. The analysis values in table 3 affirm the comparability of the finished beers in terms of bitterness units and concentrations of iso-alpha-acids and alpha-acids.

Analysis of aroma compounds of the beers using Headspace Trap GC-MS Analysis [2] showed that, due to early hop addition, only few important hop aroma compounds could be identified in the beverage. The slightly higher level of linalool in the Akoya beer amounted to 32 μ g/l (7.7 μ g/l in the Perle beer). This well-known hop aroma compound was thus slightly above the odour threshold value for linalool published [3] in a commercial pale full-strength beer (27 μ g/l), thus contributing to overall beer aroma. This analysis also shows in general that the beers are analytically comparable.

As brewers are also very much interested in the quality of bitterness, in addition to other aroma attributes, tasters were also asked to focus on bitterness quality and overall impression of both beers. Visitors to the trade exhibition assessed quality of bitterness of beers as being identical – overall impression of the beers was also comparable (fig. 2). The higher bitterness intensity might also be attributed to the slightly higher analytical bitterness units, possibly resulting from a more efficient yield in the case of Akoya.

In the context of tastings, tasters were also asked to voice a preference. This did not turn out to be significant (fig. 3). In a nutshell: the new, more climate-resistant variety does not differ in terms of taste.

In addition to this brewing test, the variety attributes of Akoya from several harvesting years were assessed positively in the Hopsteiner pilot brewery newly built in Mainburg, in cooperation with other breweries. It is, however, not possible to describe the results in the context of this publication.

Conclusion

Hopsteiner’s response to climate change is called Akoya. In many years of cultivation

and brewing tests, the new hop variety has proven that it has the required attributes to be fit for the future. In close cooperation with hop farmers and brewers, Hopsteiner intends to consistently and sustainably increase the acreages under cultivation with Akoya. Only a mix of new, adaptable varieties and clever use of agricultural land will be able to ensure the future economic viability of agriculture and, thus, hop cultivation. In order to accelerate necessary changes, it will be important to strike out in new directions, i.e. from cultivation up until use and hop refinement. The market will benefit from new varieties. They will be exceptionally high in yields, improved in terms of cultivation and capable of unfolding all their characteristics in high-quality beers. With their own research program and with the development of new bred varieties, Hopsteiner makes an important contribution to a sustainable hop industry. ■

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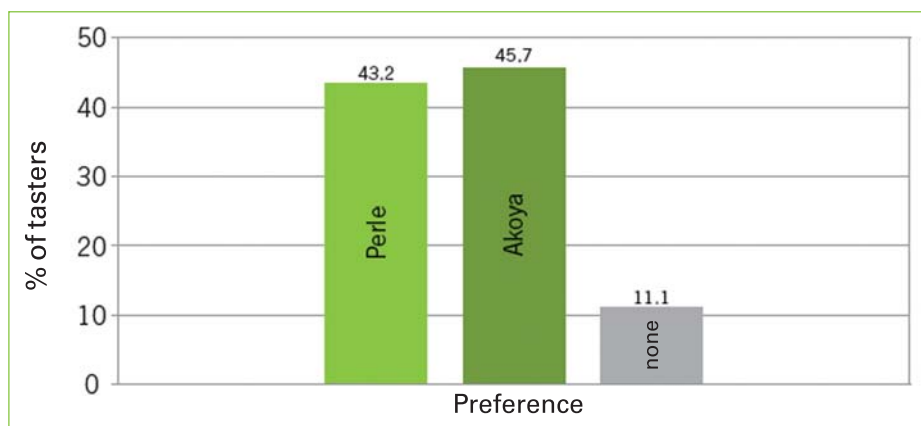


Fig. 3 Preference of tasters in terms of overall impression of beers

to thank all test growers in the Hopsteiner hop breeding program. Without their valuable support, it would have not been possible to implement the breeding successes described.

References

1. Matthews, P.; Coles M.; Pitra, N.: "Next Generation Sequencing for a Plant of Great Tradition: Application of NGS to SNP Detection and Validation in Hops (*Humulus Lupulus* L.)", *BrewingScience* 66 (Nov/Dec), 2013, pp. 185-191.

2. Schmidt, C.; Biendl, M.: "Headspace Trap GC-MS Analysis of Hop Aroma Compounds in Beer", *BrewingScience* 69 (Jan/Feb), 2016, pp. 9-15.
3. Hanke, S.: "Untersuchungen zum Einfluss der Hopfungstechnologie auf die Geschmacksstabilität und Harmonie untergäriger Biere", doctoral thesis, TU München, Weihenstephan, 2009.