

# Triskel and Aramis

**NEW HOPS FROM ALSACE** | The original goal of the Alsatian hop breeding program was to develop a hop with higher and more consistent alpha acids than Strisselspalt, yet having the same bittering and aroma profile. The selection Aramis is believed to have achieved this goal. Triskel, on the other hand, is a selection with a bitter profile similar to Aramis, but with a distinct and sophisticated orange/citrus/honey aroma unique in commercial hops.

**FOR MORE THAN A CENTURY**, the Alsace hop region, like most of the other continental European hop regions, was highly dependent on one old landrace variety used primarily for Lager and Pilsner beers. In Alsace, this landrace hop was Strisselspalt, known in some brewing circles simply as “Alsace”. Strisselspalt, like other European landrace hops (Saaz-types, Hallertau and Hersbrucker) is low in alpha acids, high in beta acids, and has a high ratio of polyphenols and green material to alpha acids as compared to most of the hops developed and released in the last 50 years. The low alpha acids and high production costs of these landrace hops became an economic issue for many brewers in the last quarter of the 20<sup>th</sup> century, creating a push for high alpha and higher yielding hops, often without much regard to the flavor profile. But more traditional brewers were more concerned with maintaining the overall flavor profile of these landrace hops, but wanted hops with better agronomics and improved alpha. This gave the hop breeders of the 1970s and

1980s two markets to pursue: cheap high alpha and higher yielding replacements for the traditional landraces.

Breeding for low-cost alpha is straight forward, but breeding for flavor characteristics is far more complex. On a fast track, a new hop variety requires 8-12 years to breed and commercialize. So the hop breeder must be thinking ahead and “leading the target” when making crosses and selecting seedlings. What will brewers want ten years from now? For brewers who want improved versions of the landrace hops, they want something with identical flavor characteristics, but higher yielding and more agronomically reliable than their finicky counterparts. As the flavor of any hop will vary from field to field and from crop year to crop year, judging if a new hop is close to its target is problematic. This philosophy also does not acknowledge the possibility that a new hop could have a more desirable flavor than the old landrace hop – a topic that will be explored later.

## Evolution of new “traditional” aroma hops

The European landrace hops are prized not only for their sophisticated aroma properties, but also for the refined, crisp bitterness they impart to beer. Since the 1970s, there has been a great deal of controversy about what chemical characteristics are responsible for this, or if this is even true. But the proponents of such thinking have advanced a few theories that do guide brewers and hop breeders in selecting new cultivars:

There are three major alpha acids in hops, n-humulone, co-humulone and ad-humu-

lone, each producing their corresponding iso-alpha acids in beer. To a first approximation, all three are considered to be the same, but in reality they all behave differently in the brewing process. Many brewers believe the bitterness of iso-co-humulone in beer is harsher and more lingering than the bitterness of iso-n-humulone or iso-ad-humulone [1], but this is far from universally accepted. The European landrace varieties are lower in co-humulone content than most of the varieties introduced in the last 40 years, and many brewers believe this is one reason high alpha hops have inferior flavor characteristics in comparison to the landrace hops.

Hop polyphenols add body and astringency to beer, contribute to its overall complexity and balance, and may attenuate bitterness in beer. If true, this means replacement hops for landrace hops should also have a high polyphenol to alpha ratio to maintain this balance and the polyphenol profile should be similar to that of the landrace hops. Some brewers propose hop polyphenols may even act as anti-oxidants in beer and slow staling [2].

The landrace hops all have about as much or more beta acids than alpha. Thinking of the 1970s and 1980s this was important for a replacement for landrace hops, but this was probably largely due to the practice of using leaf hops in their operations. As baled leaf hops oxidized in storage, the oxidized beta produced increased bitterness to replace the bitterness lost due to loss of the alpha. Preventing oxidation by storing as pellet or extract makes this less important. On the other hand, intact beta acids added to the kettle may actually contribute something positive to the overall bitter impression [3]. The super alpha hops introduced in the last two decades generally have only about 30 percent as much beta as alpha – changing this balance.

Landrace hops have oil profiles that differ considerably from those of generic high alpha hops. The landrace hops tend to have a higher ratio of sesquiterpenoid compounds (15 carbon atoms in a particular configuration) vs. terpenoid compounds (10 carbon atoms with a similar configuration). The sesquiterpenoid compounds are believed to



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**Triskel has a distinct and sophisticated orange/citrus/honey aroma**



**The new variety Aramis is the product of a cross between Strisselspalt and Whitbread Golding**

be responsible for the spicy, herbal, cedar, tobacco and leather-like aroma notes characteristic of the landrace hops. The terpenoid compounds tend to be floral, citrus, piney and minty.

### Selection of Aramis and Triskel to meet brewer needs

The Alsace hop breeding program was conceived in 2000 and the first crosses made in 2001. The initial target of the program was to develop a hop with higher and more consistent alpha content than Strisselspalt, but with identical flavor properties. Crosses are made each spring and thousands of seeds are collected each fall. The seeds are germinated over the winter and screened for vigor and disease resistance. Promising seedlings are planted in an outdoor garden and observed for 2 - 3 years. The most promising 5 - 10 percent of these plants are harvested and the cones analyzed for alpha and

screened for sensory properties. Perhaps a dozen or so plants are selected each year from the thousands of original seedlings for expansion into small plots of 44 plants. These new plantings must mature for two years before harvesting and test brewing of the most promising. These small test plots are usually observed and tested for 2 - 3 harvests before a decision is made for further expansion. Breeders are looking for consistent yields and disease resistance, as brewers are test brewing and looking for selections that suit their needs. If both agree a selection is interesting, it is expanded into small-scale commercial production of a few hectares. Further expansion usually requires a financial commitment by a brewer.

Aramis, a cross of Strisselspalt with a male seedling of WGV (Whitbread's Golding Variety), came out of this selection process and was found to be interesting to a number of Strisselspalt-using brewers because of its characteristic mild, non-lingering

bitterness and an aroma profile hard to distinguish from Strisselspalt. Triskel, a cross of Strisselspalt with a male seedling of Yeoman, was commercialized out of the program a bit more rapidly than Aramis because of its distinctive orange/citrus aroma and very positive feedback from brewers. The aroma of Triskel is distinctively different from Strisselspalt and the other landrace hops, but the bitterness profile does seem to be similar – that is, it imparts a mild, crisp bitterness to beer.

Table 1 compares the most general properties brewers use to evaluate hops of a number of different cultivars grown in the Alsace region. Not only is the alpha of Strisselspalt low, it tends to be quite variable. The alpha of both Aramis and Triskel are not only much higher, but more consistent. The co-humulone content is low in both, similar to Strisselspalt, and lower than in most bittering varieties. The oil content is much higher than Strisselspalt, but is not

## COMPARISON OF VARIOUS HOP CULTIVARS GROWN IN ALSACE

	Aramis	Strisselspalt	Triskel	Hallertau Tradition	Perle	Nugget	Columbus
Alpha acids %	7.9 - 9.3	1.8 - 2.5	8 - 9	3.8 - 6.0	7 - 8	9.5 - 13	9.5 - 12
Beta acids %	3.8 - 4.5	3 - 6	4.0 - 4.7	3 - 6	4.5	3 - 6	4.5 - 5.5
Cohumulone %	20.5 - 21.3	20 - 23	20 - 23	25 - 30	28 - 30	24 - 30	30 - 35
Total oil mg/100 g	1.2 - 1.6	0.6 - 0.8	1.5 - 2.0	0.9 - 1.4	1.5	1.5 - 2.3	1.4 - 2.0
Sesquiterpenes in oil %	52	41	30				
Total polyphenols %	3.6 - 5.1	3.8	3.7 - 5.4	5.7	3.6		
Yield (2012) kg/Ha	2480	1760	2260				
Powdery mildew tolerance	(0)	(++)	(+++)				
Downy mildew tolerance	(-)	(++)	(++)				

Table 1

increased in proportion to the alpha. The composition of the Aramis oil looks more landrace-like – very high in sesquiterpenes. The oil of Triskel on the other hand looks less landrace-like. This is not surprising as it was selected for its orange/citrus notes.

On the agronomic side, Triskel has better powdery mildew tolerance than Strisselspalt and at least equal tolerance to downy mildew. This makes Triskel a good choice for organic gardening. One commercial plot of Triskel became organic certified in 2012 after a 3 year transition period. The organic hops of 2012 were of excellent quality. Aramis is more susceptible to both powdery and downy mildews and is not as good a candidate to grow organically – although 0.7 Ha is under organic cultivation.

Table 2 compares the oil profiles of Aramis and Triskel to Strisselspalt. Alpha adjusted, the oil profile of Aramis is nearly identical to Strisselspalt. This is not surprising considering the similarities in the aroma profiles. The oil profile of Triskel on the other hand is distinctly different from Strisselspalt. There is much more orange/citrus character to Triskel than to Strisselspalt, so one would expect differences in the oil profile. Triskel was not selected as a substitute for Strisselspalt, but brewers looking for a distinctive orange/citrus aroma that is not overpowering, yet still complex and sophisticated will find Triskel interesting.

### ■ Brewer experience with Aramis

In 2004, Aramis was selected on both agronomic performance and hand evaluation for expansion to a 44-plant test plot that was planted in 2005. A commercial brewer of traditional lager beers (and a long-time user of Strisselspalt) brewed test beers from these hops from the 2006 and 2007 harvests. Both crop years, these 100 percent Aramis test lagers were judged to have a pleasant, non-lingering bitterness similar to Strisselspalt, and a hop aroma not unlike Strisselspalt. Aramis was expanded to 3 Ha in 2008, to 16 Ha in 2010, and to 33 Ha in 2011.

With sufficient amounts of Aramis available to make hop pellets, more brewers became interested in brewing with Aramis. Brewer impressions were mostly favorable, agreeing Aramis is a reasonable substitute or replacement for Strisselspalt, both for kettle additions and for dry-hopping. When dry-hopping to the same flavor level, Aramis shows a considerable mechanical advantage in beer recovery over Strisselspalt because so much less hop powder needs to be removed. Dry-hopping with Aramis results in an aroma similar to using Hallertau mf., Hersbrucker or Strisselspalt. One gets a clove/cedar wood/sandalwood, spicy aroma as opposed to the more grapefruit, catty, piney aroma one gets from the more fashionable American hops used for dry-hopping in recent years.

A 2012 publication [4] reported results of brewing with Strisselspalt, Aramis and Alsatian-grown Hallertau Tradition at the pilot brewery at Weihestephan. The taste panel assessing the beers reported the bitter perception of the Tradition brew was stronger than those of the Strisselspalt and Aramis brews. The Strisselspalt brew was described as more floral than the others, the Aramis brew more hoppy, floral and citrusy, and the Tradition brew more fruity. The conclusion was Aramis has much potential and is at least as good as, if not superior to Tradition.

The real potential of Aramis was demonstrated by a Pilsner-style beer made by the Urban Chestnut Brewing Company of St. Louis and served at the 2013 CBC convention in Washington DC. This 34 IBU beer (measured) was made with 100 percent Aramis and German Pilsner malt (12.5 OG, 2.6 FG), with a pH of 4.38 and 5.6 percent ABV. Some hops were added late in the kettle and some in the whirlpool. The beer, even with a relatively high bitterness level, was very drinkable, well balanced, and yet had enough character to it to be interesting. It compared very favorably to European Pilsners made with more traditional aroma hops.

### ■ Brewer experience with Triskel

Triskel was brought into commercial production a few years after Aramis so it has

OIL PROFILES OF ALSATIAN HOPS (2011 CROP – DATA IN MG/ 100 G)

	Strisselspalt	Aramis		Triskel	
	Lot 533	Lot 905	Lot 908	Lot 94	Lot P09-18
myrcene	396	833	574	948	913
caryophyllene	46	114	97	83	68
aromadendrene	10	13	12	1	0
farnesene	1	4	2	0	0
humulene	100	287	251	208	178
β-selinene	19	35	28	59	44
α-selinene	22	41	33	68	51
Selin-(4,7) + (3,7)-diene	26	42	37	1	0
Germacrene B	33	48	42	1	0
linalool	7	16	12	16	12
geraniol	2	5	4	6	5
α-eudesmol	6	6	7	1	0
β-eudesmol	5	3	6	1	1
Selina-11-en-4-ol	1	3	2	6	4
Alpha acids %	4.1	9.0	10.3	8.7	7.4

Table 2

## FLAVOR PROFILES OF TEAS MADE WITH ARAMIS AND TRISKEL

	Strisselspalt	Aramis	Triskel
Spicy	3.9	4.1	4.9
Herbal	5.0	5.6	5.3
Estery	3.2	3.1	4.0
Fruity	3.0	2.8	3.6
Citrus	2.8	2.7	3.5
Blackcurrant	2.2	2.4	2.5
Fruitgum	1.1	1.2	2.1
Floral	3.0	2.6	4.0
Geraniol	2.0	2.8	3.6
Resinous	2.9	2.7	2.9
Woody	3.2	3.3	3.3
Grassy	3.7	3.8	3.1
Licorice	1.0	1.1	2.0
Tobacco	1.7	1.4	2.5
Fatty acid	1.4	1.2	1.4
Cheesy	1.0	1.0	0.8
Soapy	1.2	1.6	0.9
Rancid	0.6	1.1	0.8
Sulphidic	2.0	2.4	2.3
Cooked vegetables	3.0	3.3	2.9
Metallic	0.2	0.1	0.5
Hop flavor acceptance	6.3	5.7	6.5
Hop flavor intensity	5.1	5.8	6.0

Table 3

less brewing history. Commercial production of Triskel began in the fall of 2010 when 22 Ha were planted. Although Triskel seems to have a similar bittering profile to the landrace aroma hops, its unique aroma sets it apart from these. The orange/citrus, earthy/spicy aroma of Triskel is also nothing like the grapefruit/catty/piney citrus notes found in many of the popular American flavor hops used for IPAs in recent years. Compared to the citrusy English hops, the citrus notes of Triskel are sweeter and more honey-like. As Triskel seems to have the bittering and spicy aroma characteristics of the landrace hops, and in addition it imparts some unique orange/earthy/honey notes to beer as well, Triskel could be considered a value added hop for open-minded brewers. All this makes Triskel somewhat unique and

perhaps this explains its recent following with many small brewers.

Most brewers experimenting with Triskel have used it in some sort of dry-hopping or late hopping scheme. Here, the spicy/orange notes seem to come out and blend well with fermentation and malt notes. An example is an English-style Pale Ale brewed by the Urban Chestnut Brewing Company of St. Louis, served at the 2013 CBC Convention. The 5.7 percent ABV ale had 27 IBUs (measured), was made with English Marris Otter Pale Ale malt (13.4 OG, 2.8 FG) and had a pH of 4.30. This 100 percent Triskel brew was hopped early and late in the kettle and in the whirlpool. In addition, the ale was dry-hopped (0.6 kg/bbl) for one week. Tasters of the ale commented on the obvious citrus/orange note and how it blended well with the spicy and earthy

characteristics of the beer. How much of the latter were from the hops is hard to judge.

### Hop tea evaluations of Aramis and Triskel

For a quick comparison of aroma properties of Strisselspalt with Aramis and Triskel, a European brewer made hop teas (hops steeped in water). Flavor panelists were asked to quantify different aroma attributes of the teas. The results are presented in table 3. The aroma profiles of Strisselspalt and Aramis appear very similar. Triskel is something of an outlier with stronger citrus, spicy and floral flavors. This is consistent with brewing results suggesting similarities of Strisselspalt and Aramis, but that Triskel is a bit different.

### Summary

Aramis has a bittering, and aroma profile similar to the traditional European landrace hops and is a good substitute for them. The increased alpha and oil concentration of Aramis is a definite advantage for reducing beer loss when dry-hopping. Triskel also has a pleasing, non-lingering bitter profile and has a unique, yet not overpowering orange/spicy aroma that results in beers with high drinkability, but yet still has enough character to be interesting. Triskel appears to be well suited for organic farming, Aramis less so. ■

### Bibliography

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