



# Quality of beer from historical and current varieties of spring barley with addition of valerian and hops

Michaela Némethová<sup>1\*</sup>, Vratislav Psota<sup>2</sup> and Tomáš Gregor<sup>1</sup>

<sup>1</sup> Department of Food Technology, Faculty of AgriSciences, Mendel University, Brno, Czech Republic

<sup>2</sup> Research Institute of Brewing and Malting, Mostecká 971/7, 614 00 Brno, Czech Republic

\*corresponding author: [michaelanemethova20@gmail.com](mailto:michaelanemethova20@gmail.com)

## Abstract

Historic spring barley varieties can be a source of resistance to abiotic (drought) and biotic (diseases) environmental factors in breeding programs. They can be a source of the new technological characteristics of malt or sensory characteristics of beer. Beers made from Pilsner malt from two historical varieties – Chlumecky (1902) and Stupicky Starocesky (1926) and two contemporary varieties – Bojos and Sebastian (2005) were evaluated. These beers have been flavoured with valerian, which in combination with hops has been shown to have anxiolytic and sedative effects.

A comparison of elementary and sensory parameters of beers with addition of 0.5 g.L<sup>-1</sup> and 1.5 g.L<sup>-1</sup> of valerian to two different series of beers was carried out. The Chlumecky samples had the lowest content of alcohol by volume (6.17% and 5.12%) in both batch series of beer and the highest real extract in the first batch series (4.11%). The samples of beer from the Stupicky Starocesky variety had low real extract (3.57% and 3.60%) and high content of alcohol by volume in both batch series (6.34% and 5.96%). In terms of sensory analysis it means that beers brewed from the malt made from the older barley varieties – Chlumecky and Stupicky Starocesky with addition of 0.5 g.L<sup>-1</sup> of valerian had the highest overall impression.

**Keywords:** barley; malt; beer; *Valeriana officinalis*; *Humulus lupulus*

## 1 Introduction

Botanical additives to alcoholic beverages have been used in Europe since prehistoric times. Finds from pre-history indicate fermentation with a variety of fermentable sugars and botanicals. The earliest traced evidence for alcoholic beverages dates back to 9,000 years ago from the ancient Chinese village of Jiahu where residue analysis of ceramic vessel suggests a mixed beverage made with grapes, haw-thorn fruit, rice and honey. The Bronze Age burial mound at Egtveld, Denmark, dating back to 1500–1300 BCE, contained a birch-bark container with dried up traces of a mixed beverage on the inside (Verberg, 2020).

Many different botanicals were used as beer additives over the centuries. Several with clear preservative properties, some with perceived medicinal properties, some with

desired psychotropic or adulterating effects, and others perhaps just for an enjoyable flavour (Verberg, 2020).

Valerian root (*Radix valerianae*) is often combined with hops strobile (*Strobilus lupuli*) to enhance its sedative and anxiolytic efficacy. The valerian-hop combination is commercially available worldwide as an anxiolytic preparation. Valerian is originally native to Asia and Europe and hop plants are distributed throughout North America, Europe, and Asia. Valerian root shows sedative, hypotensive, anti-spasmodic and anxiolytic activities, and has been used in traditional medicine as a sleep promoting agent in the treatment of nervous states and anxiety. The anxiolytic activity is probably associated with the synergistic action of valerenic acid and valepotriates leading to the barbiturate-like effect through GABA and

the serotonergic systems modulation. The extract obtained is mainly used from the root and rhizomes to treat milder forms of insomnia and anxiety. The recommended dose of the Valerian extract is 50–100 mg administered 2–3 times a day, or as a single dose a dose of 150–300 mg of extract for about 45 minutes before sleep. In the case of using the dried root the dose should be between 1 and 2 g. (Martin and Martinová, 2014; Shinjyo et al., 2020; Bączek et al., 2022; Gammoh et al., 2023).

The advantage of Valerian is its low toxicity and low likelihood of side effects. Among the possible side effects, that are very rare, there are fatigue, abdominal cramps, chest tightness, tremors, dilated pupils. On the contrary, there is no side effect, which is common with other hypnotics after waking up – the “hangover” effect. Valerian doesn't even show interactions with alcohol and other drugs (Martin and Martinová, 2014).

Hop (*Humulus lupulus* L.), a component of beer, is a sedative plant whose pharmacological activity is principally due to its bitter resins, to the  $\alpha$ -acid degradation product 2-methyl-3-buten-2-ol. The mechanism of action of hop resin consists of raising the levels of the neurotransmitter  $\gamma$ -aminobutyric acid (GABA), an inhibitory neurotransmitter acting in the central nervous system (Franco et al., 2012). Hops has analgesic and anti-inflammatory actions mediated by its active constituent isohumulone (Gamooh, 2023).

The aim of this study was to compare properties of beers brewed from Pilsner malt made from the older varieties of spring malting barley (Chlumecky and Stupicky Starocesky) and the recent varieties (Sebastian and Bojos).

## 2 Materials and methods

Pilsner malt made from the historical and the currently grown varieties of barley was obtained from the traditional floor malthouse in Záhlinice, Czech Republic. Two samples of the Pilsner malt were made from the Czech historical spring barley varieties – Chlumecky (1902) and Stupicky Starocesky (1926) and two were made from the currently grown spring barley varieties –

Bojos (2005) and Sebastian (2005) (Table 1). All four varieties were grown under the same conditions.

Hop pellets (variety Saaz) and yeasts (Fermentis – US-05) and dried valerian root (*Radix valerianae*) were used for production of experimental beers.

Brewing sheets were prepared according to information about mashing in Pivovarství (Basařová et al., 2010) and Principles of Brewing Science (Fix, 1999).

### 2.1 Preparations and brewing

4 different batches of wort from Pilsner malt made from 4 varieties of spring malting barley were brewed. Each batch was prepared according to the same mashing scheme.

Preparation of the wort includes the following processes: mashing, wort boiling, and rest at the whirlpool. Mashing was carried out at 60 °C for 5 min, at 63 °C for 60 min, at 72 °C for 20 min, at 78 °C for 5 min. Wort boiling was 60 minutes long and hops and valerian were added. The addition of hops and valerian was: 60 min of boiling 1.0 g.L<sup>-1</sup> of Saaz, at 30 min 1.0 g.L<sup>-1</sup> of Saaz, at 5 min – 0.5 g.L<sup>-1</sup> of valerian (1st batch series) and 1.5 g.L<sup>-1</sup> of valerian (2nd batch series). Also 0.5 g.L<sup>-1</sup> of Saaz was added to the whirlpool.

Plato of the wort was measured after cooling to 20 °C, followed by pitching of the yeasts. The wort with dried yeasts (US-05 by Fermentis) was put in the fermentation containers with a sealable lid and brewing airlock. The primary fermentation was 5 days long with temperatures between 20–22 °C. Carbonation took 5 days in the dark plastic bottles with addition of 5 g.L<sup>-1</sup> of glucose and then the bottles were put in cold room (5 °C) for 2 weeks for maturation. After 2 weeks, the beer was ready for elementary and sensory analyses.

The elementary analysis of the beer was performed at the Mendel University in Brno, at Department of Food Technology. The elementary analysis consisted of the following parameters: original gravity (°P), alcohol by volume (%), real extract (%) (EBC, 2010). For the analysis, we used BeerFos FT Go.

The sensory analysis was performed afterwards, and the following parameters were assessed: aroma, taste, fullness, zest, bitterness–intensity, bitterness–persistency, overall subjective impression. The sensory panel consisted of 8 people working in the brewing industry, or beer judges.

**Table 1** Varieties of spring malting barley used

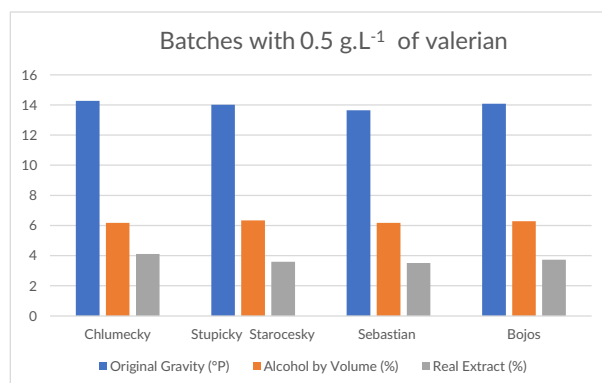
ECN	Year of registration	Variety	Origin	Type of ear
03C0600023	1902	Chlumecky	Austro-Hungarian Monarchy	2-row
03C0600021	1926	Stupicky Starocesky	Czechoslovakia	2-row
03C0602742	2005	Bojos	Czech Republic	2-row
03C0602773	2005	Sebastian	Denmark	2-row

ECN – National accession number

### 3 Results and discussion

#### 3.1 Elementary analysis of beer

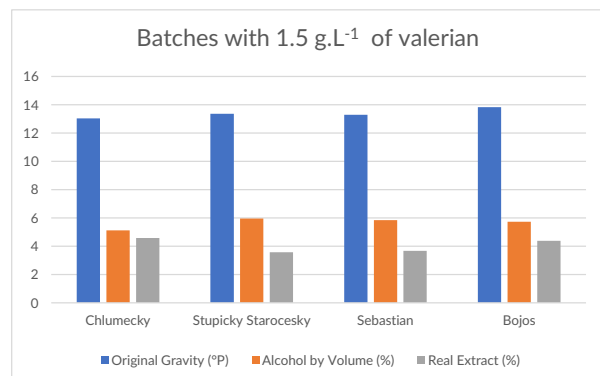
8 batches of beer were analysed. The batches were divided into 2 series. Both batch series consisted of 4 beers, each beer made from different Pilsner malt made from 4 types of the malting barley varieties. Two varieties are historical (Chlumecky, Stupicky Starocesky) and two varieties are currently grown in Czech Republic (Sebastian, Bojos). In the first series we used 0.5 g.L<sup>-1</sup> of valerian as addition. In the second series we used 1.5 g.L<sup>-1</sup> of valerian.



**Figure 1** The first batch series – beer with addition of 0.5 g.L<sup>-1</sup> of valerian

Batches with 0.5 g.L<sup>-1</sup> of valerian have been analysed. The first parameter was original gravity which was lowest in the Sebastian sample (13.65 °P) and the highest in Chlumecky sample (14.27 °P). The aim was to brew batches of beer which are roughly 13–14 °P. Alcohol by volume was the lowest in the samples of Chlumecky and Sebastian (6.17%), which in the case of Chlumecky is explained by the fact that older varieties tend to have low extract content, high protein content, low diastatic power, low final attenuation, low friability. Less amount of alcohol by volume in the Sebastian sample compared to the other samples is partly explained by lower original gravity in comparison with the other varieties in experiment. The highest amount of alcohol by volume (6.34%) was measured in the Stupicky Starocesky sample, which is connected to similar degree of final attenuation in the Stupicky Starocesky sample and the current varieties. Even though the variety Stupicky Starocesky was grown around year 1926, it has high degree of final attenuation, same as some of the modern varieties of the spring malting barley (79–82%). The amount of real extract was in range of 3.51% (Sebastian) to 4.11% (Chlumecky). High amount of real extract is caused by the low final attenuation and the low diastatic power of the Chlumecky malting barley variety. Low amount of real extract in the sample Sebastian is connected to high diastatic power and high final attenuation

(Psota, 2008; Psota et al., 2009; Némethová et al., 2021a; Némethová et al., 2021b; Zavřelová et al., 2021).



**Figure 2** The second batch series – batches of beer with the addition of 1.5 g.L<sup>-1</sup> valerian

Batches with 1.5 g.L<sup>-1</sup> of valerian showed original gravity in the range of 13.04% (Chlumecky) to 13.84% (Bojos). Alcohol by volume was lowest in Chlumecky (5.12%) which is related to low content of extract, low final attenuation and low diastatic power in the variety Chlumecky, because of its historic origin (1902). The highest amount of alcohol by volume was 5.96% in the sample Stupicky Starocesky, as in the first batch series, is associated with high final attenuation and at the same time high final attenuation is the cause of the low amount of real extract (3.57%) in the Stupicky Starocesky samples. The highest real extract was measured in the Chlumecky samples (4.59%) (Psota et al., 2009; Némethová et al., 2021a).

#### 3.2 Sensory analysis

##### 3.2.1 Older malting barley varieties

According to Figure 3, the beer made with the addition of 0.5 g.L<sup>-1</sup> of valerian had lower intensity of bitterness, persistency of bitterness, flavour, and aroma than the beer with addition of 1.5 g.L<sup>-1</sup> of valerian. Still, the batch from the 1st. series was considered better and easier to drink than the batch of the beer from the 2nd series. Some of the judges commented on the strong flavour of valerian and its suppressing intensity of maltiness in the beer, but difference in Figure 3 is minimal.

The batch of beer made from the Stupicky Starocesky variety was evaluated very similarly than the previous sample made from the variety Chlumecky. The sample from 2nd series was perceived as more flavourful. Persistency and intensity of the bitterness were higher compared to the sample from the 1st series. Overall impression was better in the sample from 1st series, as commented by the judges, valerian can cause rather strong harsh bitterness which might be unpleasant, especially for the casual beer drinkers who usually do not prefer herbal bitterness.

### 3.2.2 Currently grown malting barley varieties

The batch of beer made from the Sebastian variety from the 1st batch series was evaluated as less flavourful, less full, and less bitter in comparison with beer from the 2nd series. Overall impression was better in the sample from 1st series. The judges commented on the prominent aroma of the herbs and on moderate to high bitterness, which resembled chemicals (chlorphenol).

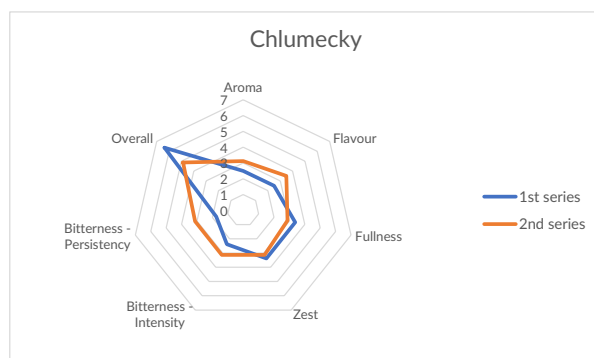
Persistency of bitterness, intensity of bitterness and flavour were described as higher in the sample from the 2nd series. Aroma was slightly less prominent in beer from the 1st series. Overall impression was better in the beer from the 1st series, which may be explained by the strong characteristic taste and bitterness of valerian.

### 3.3 Comparison of beer made from Pilsner malt made from historical and currently grown varieties of spring malting barley

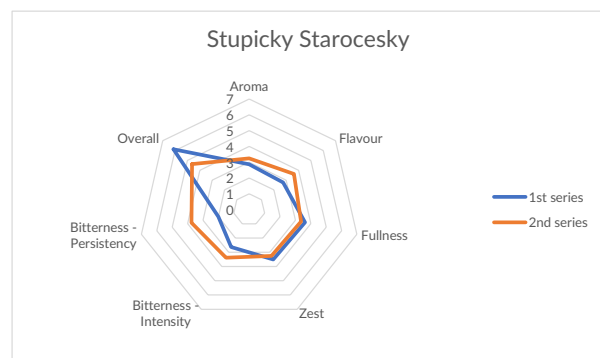
Beers which were brewed from Pilsner malt made from the older varieties (Chlumecky, Stupicky Starocesky) of the spring malting barley had a better rating of overall impression than the beers made from the cur-

rently grown varieties (Sebastian, Bojos) in the 1st and the 2nd series. This fact might be caused by higher fullness in samples of the older varieties. Fullness is caused by higher content of unfermentable sugars in wort, which is connected to low final attenuation and high real extract. If there is less content of starch (extract), usually content of nitrogen substances is higher (better foam stability) but it can increase haze in combination with higher content of beta-glucans (which is usually problematic in traditional beer styles such as Pilsner lager but may be desirable in other types if beers – hazy IPA) (Psota, 2008; Psota et al., 2009; Némethová et al., 2021a).

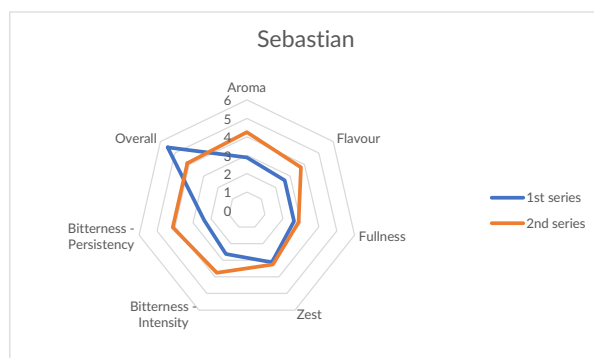
The sample from the 1st batch series with 0.5 g.L<sup>-1</sup> of valerian – Chlumecky, was evaluated as the best in terms of overall impression. Second best sample was sample from the 1st batch series with 0.5 g.L<sup>-1</sup> of valerian – Stupicky Starocesky. This is most probably caused by the higher fullness and lower herbal bitterness of these samples. The most unpleasant samples were from the 2nd batch series with 1.5 g.L<sup>-1</sup> of valerian – Bojos and Sebastian, due to lower fullness and high harsh herbal bitterness which was mouth lingering and persistent.



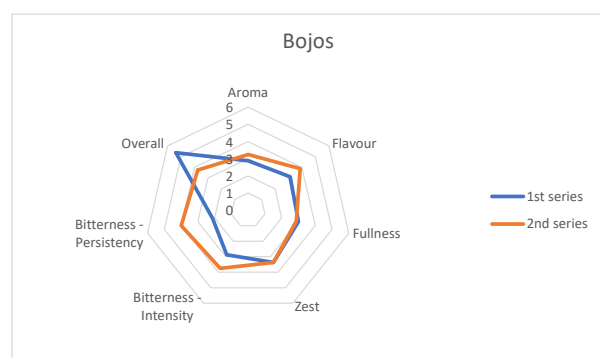
**Figure 3** Sensory profile of beer batches made from the Chlumecky variety with the addition of 0.5 g.L<sup>-1</sup> valerian (1st series) and with the addition of 1.5 g.L<sup>-1</sup> valerian (2nd series)



**Figure 4** Sensory profile of beer batches made from the Stupicky Starocesky variety with the addition of 0.5 g.L<sup>-1</sup> valerian (1st series) and with the addition of 1.5 g.L<sup>-1</sup> valerian (2nd series)



**Figure 5** Sensory profile of batches of beer made from the Sebastian variety with the addition of 0.5 g.L<sup>-1</sup> valerian (1st series) and with the addition of 1.5 g.L<sup>-1</sup> valerian (2nd series)



**Figure 6** Sensory profile of beer batches made from the Bojos variety with the addition of 0.5 g.L<sup>-1</sup> valerian (1st series) and with the addition of 1.5 g.L<sup>-1</sup> valerian (2nd series)

## 4 Conclusion

The importance of historical malting barley varieties is more and more discussed theme in the recent days, there is increasing trend of looking back to the past. Some of the historical varieties can have tremendous contribution in breeding of new varieties in means of flavour of final beer, resistance of barley to drought and to some of diseases. There are studies about quality parameters of historical malting barley varieties and malt made from them, but there is a lack of information about the beer made from this malt. Also, there is a lack of studies where the combination of beer and valerian is present, even though combination of hops and valerian is proven to have anxiolytic and sedative properties.

In our study beers made from Pilsner malt from 4 different varieties of spring malting barley (2 historical varieties – Chlumecky, Stupicky Starocesky and 2 currently grown – Sebastian, Bojos) with the addition of the medicinal herb valerian were evaluated.

Comparison of elementary and sensory parameters of beer with the addition of 0.5 g.L<sup>-1</sup> valerian and of 1.5 g.L<sup>-1</sup> valerian to two different series of beer was made.

In means of elementary analysis, we found out that the Chlumecky (1902) samples in both beer batch series had the lowest content of alcohol by volume and the highest real extract, which is in Chlumecky explained by the fact that older varieties tend to have low extract content, high protein content, low diastatic power, low final attenuation, low friability. Even though the Stupicky Starocesky variety of the spring malting barley was grown around year 1926, the beer made from it has low real extract and high content of alcohol by volume, which is connected to high final attenuation unusual for the older malting barley varieties.

The results of sensory analysis showed that the beers brewed from malt made from the older malting barley varieties – Chlumecky and Stupicky Starocesky with the addition of 0.5 g.L<sup>-1</sup> valerian had the highest overall impression among all of the samples. That was caused by fullness and lack of harsh herbal bitterness which was prominent in the samples Sebastian and Bojos from the series with the addition of 1.5 g.L<sup>-1</sup> valerian. Fullness in the beer batch with addition of 1.5 g.L<sup>-1</sup> valerian was partly masked by the strong bitterness coming from the herb itself.

## 5 Acknowledgement

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