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## EVALUATING REAL SENSORIAL STABILITY

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## Introduction

Border between fresh and aged taste is difficult to define, although is needed for brewer to set the guarantee for beer. Antioxidant capacity is hard to be used in real conditions out of forcing tests, because usually comprises beer components, of which oxidation also contribute to aged perception of beer. E.g. oxidized polyphenols change the color of beer, oxidized bitter acids change beer bitterness and oxidation of amino acids leads directly to components of aged taste. Moreover oxidation of any beer component including $SO_2$ creates radicals, which accelerate further beer oxidation. The only direct measurement of sensorial stability is by sensorial tests. Usual is vertical study, during which one batch of beer is tasted through time. Disadvantage of vertical study is low statistical capability because batch-to-batch variation is not considered. Another option is a horizontal study, at which several batches of the same age are tasted, of which disadvantage is lack of information about the course of aging. Solution can be newly proposed combined vertical-horizontal matrix test.

## Vertical-horizontal matrix sensorial test

For this study 200 batches of the same lager brand bottled in 0,5 L glass bottles sealed with crown cap were sensorial evaluated as fresh and after 6, 9 and 12 months of storage in dark room tempered to 20 deg. Celsius.

Result of sensorial evaluation was only one parameter: the Overall Sensorial Score (OSS), which was a median of Individual Sensorial Scores (ISS) given by three professional tasters. Individual Sensorial Score could have value $1 - 9$ (integers only, Fig. 1).

Because of enormous amount of samples (in total 800 tastings: 200 batches, each batch 4 times tasted) the samples were not served to tasters in anonymous glasses to separate tasting chambers, but were served as anonymous bottles at a table (fig. 2).

| Individual Sensorial Score (ISS) and Overall Sensorial Score (OSS) | |
|---|---|
| value | description of sensorial score |
| 1 | exceptionally delicious beer |
| 2 | delicious beer |
| 3 | pleasant beer |
| 4 | better than average beer |
| 5 | average beer |
| 6 | worse than average beer |
| 7 | unpleasant beer |
| 8 | disgusting beer |
| 9 | exceptionally disgusting beer |

Fig. 1 Table of Individual Sensorial Scores (ISS) used to evaluate taste of the sample. Overall Sensorial Score (OSS) of beer sample is calculated as median of ISS from three tasters.
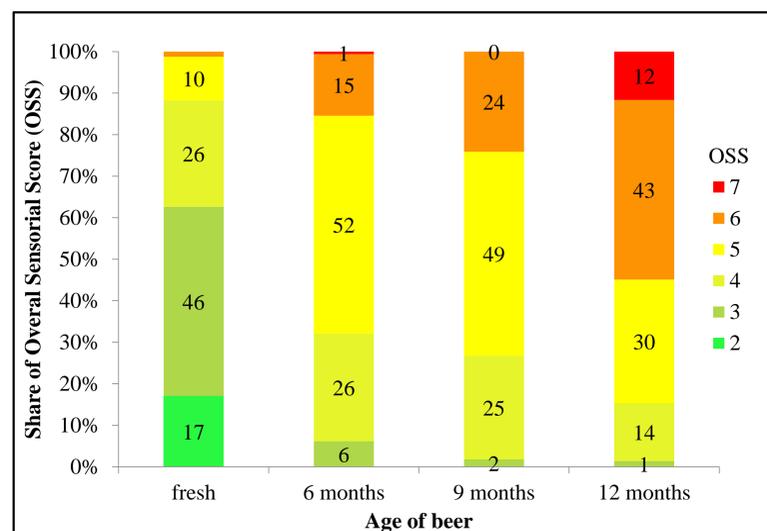


Fig. 2. Anonymous bottles for tasting.



Fig. 3. Distribution of Overall Sensorial Score among batches of one lager brand during aging.
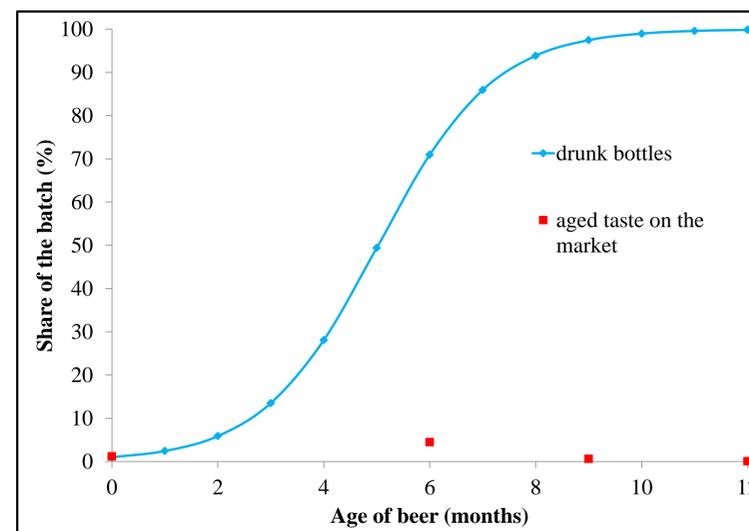


Fig. 4. Distribution of age of beer from one batch during shelf-life on the market and occurrence of aged taste of beer from one batch on the market.

## Results

For each age of beer histogram expressing shares of occurrence of Overall Sensorial Scores was calculated. Histograms of consecutive beer ages were ordered into one graph in forms of striped bar charts (fig.3).

## Definition of sensorial stability

Statistically can be sensorial stability defined as the time until the modus (most frequent) Overall Sensorial Score (OSS) does not exceed „average beer" taste (modus OSS 6 or higher on scale 1-9) and simultaneously the sum of shares of OSS „unpleasant beer" and worse (sum of shares of scores 7, 8 and 9) is not higher than 5 %.

Such a definition is very benevolent when compared to the distribution of OSS of fresh beer. This would be problem only when the whole batch would be on the market at the end of sensorial stability (or guarantee), but this is not the case, because at the end of guarantee nearly the whole batch is usually long drunk (SD – Share Drunk) according to the model logistic curve:

$$SD = 100/(1 + a \cdot b^t)$$

where $a$ and $b$ are logistic constants and $t$ age of beer. Chance of meeting aged taste on the market (SATm – Share of Aged Taste on Market) is the multiple of the share of undrunk bottles at given age and the sum of the shares of aged taste (sum of SOSS - Shares of OSS 6 and worse):

$$SAT_m = \frac{(100 - SD) \cdot \sum_{i=6}^{10} SOSS_i}{100}$$

For the case of studied beer, sensorial stability was assessed to $9 - 12$ months. The guarantee was set to 12 months and if standard logistic curve is considered for the distribution of age of beer on the market (fig. 4), the highest chance (4,5 %) to meet aged taste is 6 months after bottling. Than the chance is falling as the rest of the bottles are drunk from the market and replaced by fresh batches of beer.