STABILISATION OF THE YOUNG BARLEY JUICE USING ESSENTIAL OILS OF SELECTED PLANT SPECIES

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Abstract: The aim of this work was to investigate the possibilities of stabilisation of the juice freshly pressed from young barley by the means of the essential oils of selected plant species. Barley was grown in the laboratory into the development phase DC 29. Spring barley variety Francin was used for the experiment. Essential oils of fennel (Foeniculum), cinnamon (Cinnamomum), lemon balm (Melissa) and mint (Mentha) were used in various concentrations for the stabilisation of the young barley juice. Sensory evaluation was performed for individual samples of young barley juice after the essential oil addition. The results indicate that cinnamon and mint essential oils proved to have the best preservation effects, but the best in terms of taste the use of fennel and lemon balm essential oils.

Key Words: barley, essential oils, fennel, cinnamon, lemon balm, mint, preservation

INTRODUCTION
The many of essential oil have been proven to have significant antimicrobial, antifungal, antihelmitic and antiseptic effects against a wide range of microorganisms. Significant antioxidant properties of the essential oils were also demonstrated and thus they can be used in food industry as active preservation agents (Ghabraje et al. 2016).

Food preservation is a procedure which is able to prolong the shelf time of raw materials and foodstuff. The treated products are more sustainable in the short or long term. It is important to keep the organoleptic properties unchanged during the preservation, as well as the nutritional components of the food (Ingr 2007).

A significant characteristic of young barley is the content of active enzymes that constitute about 40% of its weight. Young barley contains cytochrome oxidase, which is responsible for cellular respiration, peroxidase, which decomposes hydrogen peroxide, catalase, oxadase of fatty acids and transhydrogenase (Dallen et al. 2010, Takano et al. 2013, Yamura et al. 2013, Lahouar et al. 2015).

Cinnamon is a plant from the Lauraceae family. Both wood and leaves, seeds, bark and roots of the plant are used. The main active agent is cinnamon essential oil, consisting mostly of cinnamaldehyde, eugenol, cinnamyl acetate, cinnamyl alcohol, o-methoxycinnamaldehyde and cinnamic acid. Other metabolites such as diterpenes, hydroxy alcohols, mucilage and tannins are also present. It is recommended to use cinnamon against anorexia, indigestion, to improve the immunity and in the case of hormonal disorders (Jahodář 2010).

Fennel belongs to the Apiaceae family. It is a biennial perennial herb desired for its fruits, elongateddiachenia (Wenzel 2014). The fruits contain mostly the essential oil with anethole, fenchone and estragole as major constituents. Epoxy-p-menthane, hydroxycoumarins, furanocoumarins, pyranocoumarins, flavonoids, beta–carotene and phytosterols are also present (Grešík 2013). It is used against flatulence and to stimulate bowel movements, the release of mucus, to increase the production of breast milk, where it also influences the course of digestion in infants, to inflamed eyes washing and for cosmetic coverings (Erdelská et al. 2008).

Lemon balm is a perennial herb from the Lamiaceae family with typical lemon scent (Erdelská et al. 2008). The plant contains hydroxycinnamic acids - rosmarinic, coumaric, caffeic and chlorogenic acid. The compounds responsible for the properties of the essential oils are citral, citronellal, geraniol, nerol, linalool, humulene, farnesyl acetate, beta-caryophyllene and eremophilene. In contains also
flavonoids, tannins and pentacyclitreprenic acids (Jahodář 2010). Lemon balm soothes the nervous system in the case of exhaustion, insomnia, headaches, dizziness and also is used for painful menstruation, treatment of heart activity and to lower blood pressure, digestive disorders and problems with gallbladder function (Wenzel 2014).

Mint is a perennial herb belonging to the Lamiaceae family. The main components of the essential oils are menthol (35–45%), menthone (15–25%), methyl acetate (3–5%) neomenthol, isomenthol, menthofuran, terpenes, flavonoids, tannins and phenolic acids (Jahodář 2010). It is used mostly to ease the pain, to suppress the sensitivity of nerve endings, to promote the excretion of bile during digestion and against diarrhea (Wenzel 2014).

**MATERIAL AND METHODS**

**Plant material**

To obtain the young barley juice, Francin variety of spring barley has been used, grown at the laboratory conditions at the temperature 22 °C. Juice from the barley grown into the phase DC 29 was extracted by the means of the instrument Healthy Juicer for the green mass processing. Essential oils of selected species of medicinal plants - fennel (Foeniculum), cinnamon (Cinnamomum), lemon balm (Melissa) and mint (Mentha) were added into fresh juice in two different concentrations (lower - 0.1 ml/l; higher - 0.2 ml/l).

The volume of barley concentrate created during the juicing was diluted with water to the ratio 1:8. The resulting solution was divided into nine samples where the sample no. 2 was conducted as a control without the addition of any essential oil and to the others essential oils were added (see Table 1). The control sample no. 2 was compared with the sample no. 1, which was prepared from the product available on the market, green barley powder from the Green Ways company (GW). The composition and antimicrobial activity of the essential oils was taken into the account during their selection.

**Table 1 List of the samples for sensory evaluation and monitoring of the effects of preservatives**

<table>
<thead>
<tr>
<th>Sample</th>
<th>Form</th>
<th>Amount</th>
<th>Essential oil</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>young barley, powder</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>2.</td>
<td>young barley, fresh</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>3.</td>
<td>young barley, fresh</td>
<td>lower</td>
<td>cinnamon</td>
</tr>
<tr>
<td>4.</td>
<td>young barley, fresh</td>
<td>higher</td>
<td>cinnamon</td>
</tr>
<tr>
<td>5.</td>
<td>young barley, fresh</td>
<td>lower</td>
<td>fennel</td>
</tr>
<tr>
<td>6.</td>
<td>young barley, fresh</td>
<td>higher</td>
<td>fennel</td>
</tr>
<tr>
<td>7.</td>
<td>young barley, fresh</td>
<td>lower</td>
<td>lemon balm</td>
</tr>
<tr>
<td>8.</td>
<td>young barley, fresh</td>
<td>higher</td>
<td>lemon balm</td>
</tr>
<tr>
<td>9.</td>
<td>young barley, fresh</td>
<td>lower</td>
<td>mint</td>
</tr>
<tr>
<td>10.</td>
<td>young barley, fresh</td>
<td>higher</td>
<td>mint</td>
</tr>
</tbody>
</table>

Selected criteria for the sensory testing were the scent, the presence of extraneous scent, the presence of extraneous flavours, flavour intensity and the total impression. 25 respondents were interviewed, of which one third were men and two thirds were women. There were 10 samples to evaluate. Then the samples were stored in the refrigerator and the preservation effects of the essential oils were monitored during a four weeks period.
RESULTS AND DISCUSSION

Sensory tests

Sensory tests were evaluated and graphically presented. At first, sensory tests comparison of the beverages prepared from the powder made by Green Ways and the juice freshly pressed from barley plants were performed.

Overview of the results (dilution ratio 1:8)

Figure 1 The comparison of fresh juice and the beverage prepared from powder

Results obtained from the monitored samples suggests that barley from GW company had, according to the respondents, better scent than fresh juice from young barley, and some respondents considered the smell of the young barley juice unpleasant. Figure 1 shows that the presence of extraneous scent was imperceptible for respondents in most cases, but 16% of respondents considered the presence of extraneous scent strong in the GW barley and 44% of respondents registered the presence of extraneous scent in the young barley juice. Taste of both investigated samples was mostly pleasant for the respondents (barley GW–56%, juice from young barley–80%).

Another set of sensory tests was performed using young barley juice with the addition of various amounts of essential oil. Cinnamon, fennel, lemon balm and mint essential oils were studied.

Figure 2 The scent of young barley juice with the addition of essential oil

It is evident from the Figure 2 that the respondents found the scent of spring barley juice with lemon balm essential oil the most pleasant, both in lower and higher concentrations (84; 80%). On the other hand, the odour of spring barley juice with higher amount of cinnamon essential oil was found unpleasant by the respondents (48%).

According to the respondents, the strong presence of extraneous scent was found in 84% of the cases in juice with higher amount of mint essential oil. As can be seen in the Figure 3, the most
unnoticeable extraneous scent was reported in the juice with higher amount of fennel essential oil (40% of the respondents).

*Figure 3 The presence of extraneous scent in young barley juice with the addition of essential oil*

During the sensory evaluation, the taste was one of the most important criteria. As you can see from Figure 4, the juice with fennel essential oil had a pleasant taste in both the lower and the higher concentration (68; 50% of the respondents). The spring barley juice enriched with higher concentrations of mint essential oil was unpleasant for 95% of the respondents.

*Figure 4 The flavour of young barley juice with the addition of essential oil*

As can be seen in Figure 5, 100% of the respondents reported the strong presence of extraneous taste in the young barley juice with higher amounts of mint essential oil. In the juices enriched with lower amounts of fennel essential oil, only 12% of the respondents didn't consider the presence of extraneous flavour as unnoticeable.

*Figure 5 The presence of extraneous flavour in young barley juice with the addition of essential oil*

According to the respondents, the most intense flavour had young barley juice with higher amount of mint essential oil (92% of the respondents). As shown in Figure 6, the weakest taste was found for the sample with a lower concentration of lemon balm oil.
The respondents agreed that the young barley juice enriched with lemon balm essential oil made an excellent impression in lower amount (76%). On the other hand, 80% of the respondents rated the juice with a higher amount of cinnamon essential oil as bad. However, cinnamon essential oil is important from the technological point of view. Despite the fact that the impression of juice with higher amount of cinnamon essential oil was rated negatively, we can see from the Figure 7 that the juice with a lower amount of cinnamon essential oil was rated as excellent by 36% of the respondents.

**The preservative effects of essential oils to the young barley juice**

In terms of the preservation effects, the results of this work showed that untreated young barley juice can be stored at temperatures 5–8 °C for about five days. Best preservation effects were found for the cinnamon essential oil.

The samples treated with cinnamon essential oil didn't show any changes during the four weeks period. Fennel and lemon balm essential oils were found to have less effective preservation properties than the cinnamon essential oil, but at temperatures 5–8 °C these essential oils also showed preservation effects for 3 weeks.

The preservation effects of mint essential oil to the young barley juice was found out to be suitable during the four weeks period. The tests of microbiological purity will be also performed as a part of future research.

The preservation of young barley was investigated by Kovářová (2013). They present methods of preservation by freezing and sterilisation in their paper. However, the enzymes and active ingredients present in young barley are very susceptible both to the high temperatures used for sterilisation and low temperatures used for freezing. The exposition to high temperatures leads to sensory changes of the colour of the sample and the taste. Freezing causes the precipitation of samples. The use of the essential oils doesn't require any thermal interference. On the contrary, the essential oils are natural products that enrich young barley juice with favourable substances.
CONCLUSION

It is evident from the obtained results that the best preservative effects were found for the cinnamon essential oil. However, the sensory evaluation of the flavour of young barley juice enriched with cinnamon essential oil was rather negative. The sample with the addition of cinnamon essential oil didn’t show any changes during the four weeks of storage. Fennel essential oil proved to have less effective preservation properties than cinnamon, but even this essential oil showed protective effects for 3 weeks. Within the sensory evaluation, the young barley juice enriched with fennel essential oil was assessed rather positively. Lemon balm essential oil, characterized by its typical lemon scent, proved to have preservation effects for 3 weeks similarly to the fennel essential oil. However, young barley juice with the addition of this essential oil was found tasty by the respondents, who rated the flavour as rather pleasant. The preservation effects of the mint essential oil to the young barley juice were also monitored in this work. Mint essential oil is characterized by its refreshing scent, even in very small quantities; its fragrance is very intense. Mint essential oil proved to be very useful preservation agent for up to 4 weeks of storage. However, according to the respondents, young barley juice enriched with mint essential oil was rather unpleasant, especially at higher concentrations of the essential oil in the sample.

The results indicate that cinnamon and mint essential oils proved to have the best preservation effects. The efficiency of essential oils was studied also in low concentrations, because the use of essential oils in larger quantities is not organoleptically acceptable. The treatment of the beverages with trace amounts of essential oil could have a positive effect also on their taste. Although the evaluation was not always positive, in terms of the product conservation the activity of used essential oils is not insignificant.

ACKNOWLEDGEMENTS

The research was financially supported by the TA CR TE02000177 „Centre for innovative use and strengthening of competitiveness of Czech brewery raw materials and products “

REFERENCES