

PROFIL BIOAKTIVNA JEDINJENJA SLADOVINE OBOGAĆENE SEMENKAMA GROŽĐA

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Sažetak:

Pivo je među najpoznatijim svetskim pićima, proizvedeno po standardizovanoj tehnologiji koja uključuje ječmeni slad, vodu, hmelj i pivski kvasac. Međutim, zahtevi konzumera za inovativnim i autentičnim pivom su doprineli razvoju mikropivara i proizvodnji zanatskog “craft” piva. Poslednjih godina je sve veći fokus na proizvodnji “funkcionalnih” craft piva sa jedinstvenim senzornim svojstvima koji sadrže druge nestandardne sirovine (koje nisu žitarice). Poseban izazov u dizajnu ovih “craft” piva je vezan za način i vreme dodavanja ovih sirovina u tehnološkom procesu proizvodnje piva (kuvanje sladovine, fermentacija, odležavanje ili pakovanje), kako bi se obezbedila bolja ekstrakcija bioaktivnih jedinjenja i njihova distribucija u finalni proizvod. Tako je cilj ove studije bio da se ohmeljena sladovina obogati semenakama grožđa kao izvorom fenolnih jedinjenja, potom sterilise i sastav bioaktivnih jedinjenja (fenolnih jedinjenja i gorkih kiselina hmelja) analizira primenom UHPLC Q-ToF MS tehnike. Sva jedinjenja su identifikovana na osnovu m/z tačne mase, tipičnih MS fragmenata i dostupnih literaturnih podataka. U analiziranim uzorcima sladovine sa/bez semenke grožđa je potvrđeno ukupno 28 fenolnih jedinjenja i 21 kiselina iz hmelja. Fenolna jedinjenja detektovana u kontrolnoj sladovini su dobijena iz hmelja ili slada i njihov ukupni sadržaj je bio 961.46 µg/100mL. Ukupni sadržaj kvantifikovanih fenolnih jedinjenja u sladovini obogaćenoj semenkama grožđa je bio značajno viši u poređenju sa kontrolnom sladovinom, odnosno 6579.77 µg/100mL (2.5% GS) i 8138.02 µg/100mL (5.0% GS). Glavna detektovana fenolna jedinjenja su hidroksibenzoeva kiselina, elaginska kiselina, flavan-3-oli i procijanidini, koji su tipična jedinjenja za semenku Prokupca. Ovo znači da većina fenolnih jedinjenja prelazi iz semenke u sladovinu tokom sterilizacije. (Izo)-α-kiseline su dominantno potvrđene u kontrolnoj sladovini, dok je udeo većine identifikovanih kiselina smanjen u sladovini koja je obogaćena semenkama grožđa. Sterilizacija ohmeljene sladovine obogaćene semenkana goržđa nakon kuvanja značajno doprinosi ekstrakciji fenolnih jedinjenja iz semenke grožđa i predstavlja ključni korak u proizvodnji funkcionalnog “craft” piva obogaćenog fenolnim jedinjenjima iz semenke grožđa.

Ključne reči: UHPLC Q-ToF MS, fenolna jedinjenja, (Izo)-α-kiseline, kuvanje sladovine.



PROFILE OF BIOACTIVE COMPOUNDS OF WORT ENRICHED WITH GRAPE SEEDS

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Summary:

Beer is one of the most famous beverages in the world, produced using a standardized technology that includes barley malt, water, hops and brewer's yeast. However, consumers demand for innovative and authentic beer have been contributed to the development of microbreweries and the production of craft beer. In recent years, there has been an increasing focus on the production of “functional” craft beers with unique sensory properties that contain non-cereal adjuncts. A particular challenge in the development of these craft beers is the manner and timing of the addition of adjuncts in the brewing process (wort boiling, fermentation, maturation or packaging) to ensure improved extraction of bioactive compounds and their distribution in the final product. The aim of this study was therefore to enrich hopped wort with grape seeds as a source of phenolic compounds, then sterilize it and analyze the composition of bioactive compounds (phenolic compounds and hop bitter acids) using the UHPLC Q-ToF MS technique. All compounds were identified based on m/z exact mass, typical MS fragments and available literature data. In total, 28 phenolic compounds and 21 hop acids were confirmed in the analyzed wort samples with/without grape seed. Phenolic compounds detected in control wort were originated from hops or malt and their total content was 961.46 $\mu\text{g}/100\text{mL}$. Total quantified phenolics in the wort enriched with grape seed was significantly higher compared to control wort, that is 6579.77 $\mu\text{g}/100\text{mL}$ (2.5% GS) and 8138.02 $\mu\text{g}/100\text{mL}$ (5.0% GS). The main detected phenolics were hydroxybenzoic acid, ellagic acid, flavan-3-ols and procyanidins, which are typical compounds for Prokupac grape seed. This means that most phenolic compounds are transferred from the seed to the wort during sterilization. (Iso)- α -acids were predominantly detected in the control wort, and the share of most identified acids was lower in the wort enriched with grape seeds. Sterilization of hopped wort contributes significantly to the extraction of phenolic compounds from grape seeds, and present the crucial step in the production of functional craft beer enriched with grape seed phenolics.

Keywords: UHPLC Q-ToF MS, phenolic compounds, (Iso)- α -acids, wort boiling.

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