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VREDNOVANJE EKSTRAKATA *PRUNUS SPINOSA* L. KAO FUNKCIONALNIH SASTOJAKA U ALKOHOLNIM PIĆIMA

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Kontinuirani rast tržišta piva i alkoholnih pića otvorio je nove mogućnosti za poboljšanje ukusa, arome i korisnosti ovih napitaka. Već hiljadu godina unazad je poznato da dodavanje različitih biljnih sastojaka u piće menja njihov ukus i svojstva. Međutim, moderna tehnologija olakšava postizanje željenih karakteristika i nudi nove mogućnosti za terapeutske efekte i senzorna poboljšanja ovog tradicionalnog pića. U ovom radu su predstavljene hemijska analiza i bioaktivna svojstva etanolnog i vodenog ekstrakta *Prunus spinosa* L. (trnjine) kao potencijalnog dodatka pivu, sa ciljem povećanja funkcionalnih karakteristika i senzornih osobina ovog napitka. Hemijske analize korišćenjem UHPLC-QToF-MS pokazale su prisustvo: derivata hidroksibenzoeve kiseline (heksozid vanilinske kiseline do 141.476 mg/100 g ekstrakta), derivata hidroksicimetne kiseline (izomer kafeoilkvinske kiseline do 306.608 mg/100 g ekstrakta, feruloilkvinske kiseline do 225.884 mg/100 g ekstrakta) i derivata flavona (apigenin 180.094 mg/100g ekstrakta). Procena bioaktivnih svojstava nesumnjivo je pokazala da oba ekstrakta trnjine imaju umeren do dobar antimikrobni potencijal, kao i sposobnost da inhibiraju formiranje biofilma, pri čemu je etanolni ekstrakt pokazao sveukupni bolji potencijal u inhibiciji rasta mikroorganizama. Najbolji antimikrobni potencijal je pokazan kod vodenog ekstrakta prema *Bacillus cereus* koja je poznati patogen identifikovan u namirnicama (MIC 0.5 mg/mL, MBC 1.00 mg/mL), dok su druge testirane bakterije bile otpornije na aktivnost testiranih ekstrakata (MIC u opsegu od 1.0- 4.0 mg/mL i MBC u opsegu od 2.00-8.00 mg/mL). Rezultati antifungalne aktivnosti su pokazali da ekstrakti prilično ujednačeno deluju inhibitorno na rast testiranih mikrogljiva, uz MIK vrednosti 1.00 mg/mL i MFK 2.00 mg/mL. Detaljnija analiza antimikrobne aktivnosti pokazala je da testirani ekstrakti trnjine značajno inhibiraju formiranje biofilma *Candida albicans* ATCC 10231; oba testirana uzorka su inhibirala formiranje biofilma na subinhibitornim koncentracijama približno 67.00 %. Uočena aktivnost se može pripisati prisustvu različitih fenolnih jedinjenja. Imajući u vidu poznat gorak ukus *P. spinosa* kao i pokazana bioaktivna svojstva njegovih ekstrakata, verujemo da bi ova biljka bila odličan funkcionalni sastojak koji će se dobro uklopiti u jedinstvena senzorna svojstva piva i sličnih napitaka. Predloženo pivo bi čak moglo da pruži dodatne zdravstvene efekte potrošačima,

balansirajući između zadovoljstva i njihove želje za zdravim sastojcima.

Ključne reči: *Prunus spinosa*; etanolni ekstrakt, vodeni ekstrakt, bioaktivna svojstva, funkcionalni sastojak;

VALORIZATION OF *PRUNUS SPINOSA* L. EXTRACTS AS FUNCTIONAL INGREDIENTS IN ALCOHOLIC BEVERAGES

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The continuous growth of beer and beverage market has opened new opportunities to improve their flavor, aroma, and benefits. It has been known for thousands of years that adding various herbs to beer changes the taste and properties of this beverage. However, modern technology makes it easier to achieve the desired properties and provides useful qualities for therapeutic effects and sensory improvement of traditional beer. This paper presents chemical analysis and bioactive properties of ethanolic and aqueous extract of *Prunus spinosa* L. (blackthorn) as a potential ingredient for beer to improve functional and sensory properties of this beverage. Chemical analyses by UHPLC-QToF-MS revealed presence of: hidroxybenzoic acid derivatives (vanillic acid hexoside up to 141.476 mg/100g extract), hidroxycinnamic acid derivatives (caffeoylquinic acid isomer up to 306.608 mg/100g extract and feruloylquinic acid up to 225.884 mg/100g extract) and flavone derivatives (apigenin 180.094 mg/100g extract). The evaluation of bioactive properties undoubtedly showed that both blackthorn extracts have moderate to rather good antimicrobial and antibiofilm potential, with ethanolic extract being slightly better in terms of inhibiting microbial growth. The best antimicrobial potential was observed with aqueous extract towards foodborne pathogenic bacteria *Bacillus cereus* (MIC 0.5 mg/mL, MBC 1.00 mg/mL), whereas other tested bacteria were more resilient towards the activity of the tested extracts (MIC in range of 1.0-4.0 mg/mL and MBC in range of 2.00-8.00 mg/mL). In terms of antifungal potential, the extracts showed rather uniform inhibitory effects towards tested microfungi with MIC value 1.00 mg/mL and MFC 2.00 mg/mL. A more in depth analysis of antimicrobial activity showed that the tested blackthorn extracts have promising antibiofilm activity towards *Candida albicans* ATCC 10231 as well, with both samples inhibiting formation of biofilm at subinhibitory levels approximately 67.00 %. Observed activity may be attributed to the presence of various phenolic compounds. Considering the well-known bitter taste of *P. spinosa* and demonstrated bioactive properties of its extracts, we believe it would be a great functional ingredient to add to the unique sensory properties of beer and similar beverages. This beer may even be able to provide consumers with additional health benefits, balancing enjoyment with the desire for healthy ingredients.

Keywords: *Prunus spinosa*; ethanolic extract, aqueous extract, bioactive properties; functional ingredients;

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