



## PROBIOTIKACIJA I FUNKCIONALNOST PIVA

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### Sažetak:

Funkcionalna hrana dobija pažnju od potrošača, koji zahtevaju hranu koja može da ispuni nutritivne potrebe, pomaže u održavanju uravnotežene ishrane i takođe imaju blagotvoran uticaj na zdravlje ljudi.

Pivo je gazirano alkoholno piće koje je prihvaćeno na svetskom nivou i njegova umerena konzumacija je povezana sa antiinflamatornim i antioksidativnim svojstvima, prednostima za gustinu kostiju i prevenciju koronarnih bolesti. Pivo takođe ima bolji nutritivni sastav u odnosu na većina alkoholnih pića, koja sadrže dovoljnu količinu hranljivih materija poput ugljenih hidrata, proteina i aminokiselina, minerala, vitamina i polifenola, bez dodatka veštačkih aditiva ili konzervansa. Polifenoli, nastali iz slada i hmelja, glavni su prirodni antioksidansi u pivu koji doprinose njegovim funkcionalnim svojstvima. U cilju daljeg povećanja ovih karakteristika piva, danas, specijalna piva, poput niskoalkoholnih ili čak bezalkoholnih piva, piva bez glutena, zanatskih piva, nepasterizovanih, nefiltriranih, sa dodatkom voća, sokova, biljnih ekstrakata itd., dostupni su na tržištu ili se istražuju. Još jedna važna karakteristika funkcionalne hrane je njihova povezanost sa prisustvom probiotika. Međutim, jedan od glavnih izazova uticaja probiotika na zdravlje je održavanje visoke održivosti (> 100 CFUig) tokom obrade i skladištenja hrane. Međutim, kako pivo sadrži iso-alfa-kiseline, etanol i nizak pH, koji sprečavaju rast i opstanak probiotičke bakterije mlečne kiseline, upotreba novih strategija, kao što je inkapsulacija, je ključna kako bi se održao njihov opstanak. Stoga su u ovoj studiji istaknute glavne nutritivne karakteristike i funkcionalne karakteristike piva (običnih i posebnih piva), u kombinaciji sa nedavnim istraživačkim aktivnostima na terenu. Uzimajući u obzir proizvodnju piva u Grčkoj, neki noviji eksperimentalni radovi su predstavljeni sa fokusom na dodavanje voćnih sokova u proizvodnju piva, korišćenje mikrokapsuliranja za poboljšanje probiotika u pivu i proceni potencijalne superiornost zanatskih i bezalkoholnih piva u poređenju sa običnim pivom. Ovaj rad naglašava veliki potencijal piva (posebno ne-alkoholnog) u svrhu funkcionalne hrane i sredstva za unošenje probiotika.

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**Ključne reči:** zanatsko pivo, probiotik, inkapsulacija, antioksidans, ishrana



## BEER PROBIOTICATION AND FUNCTIONALITY

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### Summary:

Functional foods are gaining the attention of consumers, who demand foods that can fulfil nutritional needs, help maintain a balanced diet and also possess a beneficial impact on human health. Beer is a carbonated alcoholic beverage with worldwide acceptance and its moderate consumption has been associated with anti-inflammatory and antioxidant properties, benefits for bone density, and the prevention of coronary heart disease. Beer also presents better nutritional composition compared to the majority of alcoholic beverages, containing sufficient amount of nutrients like carbohydrates, protein and amino acids, minerals, vitamins, and polyphenols, without the addition of artificial additives or preservatives. Polyphenols, originated from malt and hops are the major natural antioxidants in beer that contribute to its functional properties. In order, to further increase these beer characteristics, nowadays, special beers, like low-alcohol or even non-alcoholic beers, gluten-free beers, craft beers, unpasteurized, unfiltered, with the addition of fruits, juices, plant extracts etc., are available in the market or under research. Another important feature of functional foods is their association with the presence of probiotics. However, one of the main challenges of exerting probiotics' health effects, is the maintenance of high viability ( $> 10^6$  CFU/g) during food processing and storage. However, as beer typically contains hop iso- $\alpha$ -acids, ethanol, and low pH, which prevent the growth and survival of probiotic lactic acid bacteria, the use of new strategies, like encapsulation, is crucial to retain their survival. Therefore, in the present study the main nutritional features and functional characteristics of beers (both regular and special beers) are highlighted, in combination with the recent research activities in the field. Taking into account the beer production in Greece some recent experimental works are presented focusing on the addition of fruit juices in beer production, the use of microencapsulation to enhance beer probiotication, and evaluating the potential superiority of craft and non-alcoholic beers compared to regular beers. The present work highlights the great potential of beer (especially non-alcoholic) to serve as functional food and vehicle of probiotic delivery.

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