

## **Abstract of doctoral thesis „Production of beer with reduced ethanol concentration”**

Beer is a drink known for millennia. With the development of civilization, this drink has also evolved to become one of the most popular beverages in the world. Nowadays in Europe various styles of beer are being produced. Beer production in Europe is estimated to 300 bln hl per year. In recent years the biggest growth is observed in the branch of non-alcoholic beers.

Doctoral thesis „Production of beer with reduced ethanol concentration” is focused on review of available methods for low-alcohol beer production and designing new approaches for the production of abovementioned beverages. The study is interdisciplinary in nature, combining knowledge from food technology, chemical engineering and microbiology.

In the course of the research, numerous beers with reduced alcohol content were obtained using physical methods including changes in the preparation of raw materials and the removal of ethanol from the finished product, as well as biological methods involving interference with the biochemistry of the production process. Tested methods for the ethanol removal were distillation, rectification, vacuum distillation and pervaporation. Methods focused on changes in fermented product were changes in the mashing regime in order to lower the level of fermentable sugars, interrupted fermentation, cold contact process, fermentation using strains *Saccharomyces ludwigii* and *Monascus ruber*, co-fermentation using *Saccharomyces cerevisiae* and *Lactobacillus brevis*. Moreover non-fermented beer substitutes was produced.

Non-alcoholic products were obtained using vacuum distillation and by producing non-fermented beer substitutes. Beverages with maximal acceptable ethanol concentration in Poland (0,5 % vol.) were produced using rectification, pervaporation, interrupted fermentation and cold contact process. Most of the other investigated methods caused in serious reduction of ethanol level but remaining ethanol concentration was still to high to consider this product as non-alcoholic in terms of Polish law.