

Summary

In recent years, we have observed a dynamic development of Polish brewing. The data of the Central Statistical Office show that beer production in Poland is growing year by year (except in 2020, where the production of all alcoholic beverages decreased due to the pandemic). Undoubtedly, it is caused by the growing demand, consumers are increasingly turning to beer, as the awareness and culture of drinking this beverage is growing up. Increased demand and greater interest in different beer styles resulted in an increase in the number of beer producers. In 2019, around 30 new breweries were created, mainly small, medium, craft and restaurant breweries (we currently have 271 breweries in operation, and 44 are under construction or planned). According to the latest reports (Piwne podsumowanie 2020 - Piwna Zwrotnica - blog piwny). Polish consumers are open to new products. In 2020, 2,071 new beers appeared, of which sour beers (Sour Ale) account for as much as 13,3% (2% more than in the previous year), thus ahead of many popular styles, i.e., lager (4,2% of the production of new beers), pils (4%), wheat (3,9%) or porter (4,5%). Despite the annual increase in the production of sour beers in Poland, there is still little literature data on the method of their production.

The main goal of the research was to develop a technology for producing sour beers, to understand the mechanisms occurring during production, to obtain a standardized product with reproducible taste qualities. The conducted research is also intended to supplement the knowledge on the propagation of lactic acid bacteria on malt wort and their use in a mixed fermentation as well as their role in shaping the bouquet of aromatic beer. To achieve the set goals, five experiments were planned and carried out with the use of one *Lactobacillus brevis* strain.

The obtained results show that the number and viability of the lactic acid bacteria propagated on the malt wort are significantly influenced by the wort extract, temperature, and time of the process. It has been shown that the best results can be obtained by 3-day propagation at 25 °C in a wort with 12 °Plato extract, and the dose of bacteria inoculated before propagation should be about 1×10^6 cells / ml (a higher dose does not result in faster biomass growth).

Another experiment confirmed that hops adversely affect the growth of lactic acid bacteria and that even a small amount of it in the wort (4 IBU) causes problems with acidification. The research also confirmed that the order of biomass (bacteria and yeast) inoculation during fermentation has a large impact on the amount of fermentation by-products and the quality of the beer obtained. To obtain a sour beer with specific characteristics, it is first necessary to carry out lactic fermentation, and after three days alcoholic fermentation.

In the research, the influence of supplementation of the malt wort with magnesium and zinc ions on the course of lactic acid and alcoholic fermentation, sugar utilization and the amount of fermentation by-products was also checked. It was proved that supplementation of the wort with zinc had a negative effect on the course of lactic acid fermentation, while positively on alcoholic fermentation. The supplementation also influenced the amount of produced organic acids and volatile compounds during mixed fermentation.

Summing up, the conducted research resulted in a significant extension and deepening of knowledge on the propagation of lactic acid bacteria on malt wort and mixed fermentation carried out by the *Lactobacillus brevis* WLP672 strain and the *Saccharomyces cerevisiae* Safale US-05 yeast.

Key words: lactic acid bacteria, propagation, wort acidification, sour beers, aromatic profile, physicochemical characteristic of beer.

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