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Title: Technological conditions in shaping the quality of special malts from legume seeds and the potential of their use in the food industry

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Abstract:

Legume seeds are one of the key groups of plant products intended for feeding both humans and farm animals. These seeds are one of the most important sources of protein and calories in the human diet. Unfortunately, these seeds have many disadvantages that make them difficult to use in various food production processes. For this reason, various methods of processing legume seeds are increasingly being tested to reduce their content of anti-nutritional ingredients, improve their digestibility, taste and smell, and facilitate mechanical and thermal processing. The malting process in the food industry is currently used mainly for processing cereal seeds, primarily barley. The malting process uses the seed germination process, so it can potentially also be used to modify legume seeds, which indicates the validity of the research. The aim of the research was to subject legume seeds to the malting process and technological assessment of the produced malts, as well as to examine the possibility of using malts from legume seeds in brewing technology, as beer production is the most important sector of the food industry that uses malt. The research results were presented in the form of a thematically coherent series of scientific publications, which consists of five research papers. As a result, the research showed what changes the malting process causes in legume seeds and the usefulness of legume seed malts in brewing technology. A technology for producing malt from green lentils and a method for producing wort from this malt were developed, which allows the production of gluten-free beer. Based on the results obtained, it was determined that malting of legume seeds such as: chickpeas, beans, peas, grass pea, lupin, lentils, soybeans, and vetch in a process similar to the process of producing Pilsner-type barley malt does not allow for the production of malts with acceptable technological parameters to produce wort. The use of the addition of enzyme preparations containing amyloglucosidase, protease, α-amylase, β-glucanase, cellulase, endopeptidase, hemicellulase and xylanase did not satisfactorily improve the wort production process. However, it has been shown that it is possible to obtain brewing worts from Pilsner malt with a 30% addition of malt obtained from legume seeds subjected to the gelatinization process before mashing. The next part of the research included modification of the malting process of three varieties of lentils and two varieties of beans and analysis of technological parameters of the produced malts based on congress mashing. In addition, malt and seeds were tested for tenderness, protein, fiber, phytic acid, and starch content. It has been shown that modifying the malting process significantly improves the technological parameters of green and brown lentil malt, such as filtration time and extract content in the wort. Malts obtained from legume seeds had a lower starch and phytic acid content than unmalted seeds, while the protein content in malts was higher than in seeds before the malting process. All malts were much more brittle than unmalted seeds. Subsequent studies analyzed how the process of seed malting and malt mashing affects the content of raffinose oligosaccharides in lentil and bean malts and in the obtained worts. Malts made from lentil and bean seeds were characterized

by a reduced content of raffinose and stachyose. Malting reduced the raffinose content in lentil seeds by 80-96% and in bean seeds by 68-78%. The content of stachyose was reduced to a similar extent, by 79-95% in lentil malts and 63-79% in bean malts. The next publication describes how the malting process affects the content and type of volatile compounds in lentil seeds. The analysis of volatile compounds showed that the aldehyde content in lentil malts is higher than in unmalted seeds, and extending the seed germination time increases the content of these substances. The malting process reduced the amount of alcohol in lentil seeds. The research also showed that only green lentil seeds were characterized by a significant share of terpenes (such as carene or limonene) in the content of volatile compounds, and the malting process had an impact on the reduction of the content of these ingredients.

In fifth publication, an improved method of malting and modified mashing process, which enabled the production of gluten-free beer with a reduced alcohol content from green lentil malt was presented. The developed malting and mashing process allowed to hydrolyze the starch contained in the malt and obtain an innovative, gluten-free beer with a reduced alcohol content from lentil malt.

The articles constituting a single-topic series of publications present the process of malting legume seeds and the impact of this process on legume seeds, various physicochemical parameters, and basic technological features of the obtained malts. The possibility of using green lentil malt in brewing technology was also indicated. The results obtained during experimental work also indicate that the use of malt from legume seeds may bring interesting results in the production of new types of food with reduced nutritional content and modified aroma, which indicates the validity of continuing research on malt from legume seeds in the future.