

ABSTRACT

Identification of aroma compounds responsible for the flavor of pumpernickel bread produced using traditional technology and type of pumpernickel bread produced from raw materials with a reduced content of gluten proteins.

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In this study, there were identified key aroma compounds responsible for the flavour of pumpernickel bread. For this purpose, a sensomic approach was used based on the following steps: isolation of odors compounds by SAFE and SPME extraction, determination of odor-active compounds by gas chromatography-olfactometry (GC-O), identification by gas chromatography and mass spectrometry (GC/MS), quantitative analysis using labeled isotopomers (SIDA) and calculation of the aroma activity value (OAV). On this basis, it was found that the aroma of pumpernickel is shaped by a mixture of 23 aroma compounds (OAV>1), of which the highest OAV values had: 2-methylbutanal (OAV=4560) and 3-methylbutanal (OAV=6660) with malty odor, 3-(methylthio)propanal (OAV=2047) with boiled potato odor, 3-hydroxy-4,5-dimethyl-2(5H)-furanone (OAV=1233) with lovage odor, dimethyl trisulfide (OAV=475) with cabbage odor and 2-phenylethanol (OAV=414) with rosy odor. A detailed quantitative analysis of pumpernickel aroma compounds carried out at various stages of its production showed that the pumpernickel aroma is formed mainly during baking, but the fermentation process also affects the formation of key aroma compounds, incl. ethyl acetate, acetic acid, 2,3-butanedione. Furthermore, the addition of malt and fiber affects the concentration of a few key aroma compounds in the final product: 2- and 3-methylbutanal, 3-hydroxy-2-methyl-4H-pyran-4-one and 4-hydroxy-3-methoxybenzaldehyde. Subsequently, conclusions was reached that replacing rye flour with rice flour or oat flour gives the opportunity to produce gluten-free pumpernickel and very low gluten pumpernickel with highly acceptable beneficial sensory features to consumers. Samples of new pumpernickel were detailed sensory, texture, color and odor compounds analyzed. The results showed that

the pumpernickel sample with 30% addition of rice flour was the most desirable sample in terms of sensory aspect, while the other trials with the addition of raw materials with a reduced content of gluten proteins were also evaluated positively. The odor profile assessment showed that in the aroma of classic pumpernickel there are strong aroma notes such as brown, caramel and malt, while in gluten-free pumpernickel there is additionally a hint of oat and fat, and in pumpernickel with a very low gluten content, a buttery note. A comparison of the content of individual aromatic compounds showed that the addition of rice or oat flour resulted in a decrease in the content of 2- and 3-methylbutanal, sotolon, methional and vanillin, while this decrease was more pronounced in the case of the addition of oat flour. By contrast, these samples were characterized by a higher concentration of 3-methyl-1-butanol, and in the sample with 70% addition of rice flour, more than 70 times higher content of 2,3-butanedoin, which is probably responsible for the buttery note noticeable in this bread.

Keywords – bread, leaven, aroma compounds, pumpernickel, gluten-free, very low gluten, gas chromatography, texture, GC-O, OAV, odor profile analysis, sensory evaluation

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