ABSTRACT

The high temperature used during thermal processing causes the formation of a number of harmful to health substances, including products of triacylglycerols oxidation and polymerization, as well as deterioration of the quality of oils in terms of technology and organoleptic characteristics. The aim of the work was to investigate the possibility of using selected lipophilic additives in limiting polymerization and other processes of oil degradation during thermal treatment. Oils with a high content of monounsaturated fatty acids and/or a high content of substances with antioxidant activity were selected as additives.

The research was divided into three stages. In the first stage, mixtures containing the addition of 5 and 25% of cold-pressed rapeseed oil, coriander seed oil and apricot kernel oil were obtained. In the second stage, the addition of 5% and 25% of lupine and black cumin seed oils obtained by supercritical CO_2 extraction (SFE) was used. In the third stage, mixtures with the addition of 10 and 20% of cold-pressed black cumin oil and oils enriched with the addition of 0.1 and 0.2% of black cumin essential oil, which was obtained by hydrodistillation of cold-pressed black cumin oil, were prepared. Samples of refined rapeseed oil without additives (negative control) and refined rapeseed oil with the addition of TBHQ (positive control) were also prepared. All blends and oils were heated in a thin layer at 170 and 200°C. The obtained samples were evaluated in terms of the fatty acid profile, iodine value, tocochromanols content, phytosterols content, polar compounds content and the content of oxidized triacylglycerol monomers and dimers.

All mixtures and control samples were characterized by a predominant share of monounsaturated fatty acids (58.04-82.92%). The obtained mixtures differed in the content and composition of tocochromanols and phytosterols. The differences depended on the addition of cold-pressed oil or oil from SFE extraction. The investigation showed differences between the additives applicated to limiting TAG thermal degradation. The smallest increase in the content of polar compounds at 170 and 200°C was characteristic for MOR25% (by 0.17%) and ŁSFE25% (by 4.81%), respectively. Dimers were found only in samples heated at 200°C. Among all the tested samples the lowest dimers content was found in the samples from II stage of the research, ŁUB5% and ŁSFE25% (respectively 5.03 and 2.72 mg/100 g of oil). It should be noted that a higher addition of SFE lupine oil was more effective in reducing TAG polymerization. The concentration of additives had a significant impact on the reduction of TAG polymerization also in the third stage of the research. The lowest dimers content was found in the CZAR10% samples. A significantly higher content of dimers was found in the CZAR20% sample. It was associated with a significant change in the fatty acid profile caused by the addition of more cold-pressed black cumin oil.

Cold-pressed oils and oils obtained by supercritical CO_2 extraction with a co-solvent, as well as black cumin essential oil effectively limited the oxidation and polymerization of TAG during thermal processing. The obtained data indicate the possibility of using selected cold-pressed oils as active additives to frying oils. The prepared samples were characterized by similar or higher stability compared to refined rapeseed oil with the addition of synthetic antioxidant TBHQ and higher stability compared to refined rapeseed oil without additives.

Monika Fecka
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