DSC Studies of Retrogradation and Amylose-Lipid Complex Transition Taking Place in Gamma Irradiated Wheat Starch

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Degradation resulting from gamma irradiation induces decrease in order of starch granules [1, 2] and influences the processes occurring in starch-water system [3 - 5]. Differential scanning calorimetry (DSC) was applied at present for studying the effect of radiation with doses of 5 - 30 kGy on amylose-lipid complex transition and retrogradation occurring in wheat starch gels. Influence of the conditions applied during DSC measurements and intermediate storage was tested on the possibility to observe radiation effect. Wheat starch was irradiated with ^{60}Co gamma rays in a gamma cell Issledovatiel placed in the Department of Radiation Chemistry, INCT. DSC measurements were performed for ca. 50% and ca. 20% gels during heating – cooling – heating cycles (up to 3 cycles) in the temperature range 10 – 150 °C at heating and cooling rates of 10, 5 and 2.5 $^{\circ}Cmin^{-1}$. The Seiko DSC 6200 calorimeter was used.

Decrease in amylose-lipid complex transition temperature was found already after irradiation of wheat starch with a dose of 5 kGy showing modificatin of the complex structure. The differences between the irradiated and the non-irradiated samples became the easier seen in the every foregoing heating or cooling cycle as compared to the preceeding one [4-5]. It is because that thermal treatment causes decrease of transition temperature in all the irradiated samples, with no effect or increase of that temperature observed in the non-irradiated ones. Irradiation hinders retrogradation taking place in ca. 50% gels but facilitates retrogradation occurring in ca. 20 % gels. Moreover, the expanded differences between the amylose-lipid complex formed in the irradiated and non-irradiated gels result due to their recrystallisation [4-5]. Storage of the gels induces decrease in the temperature of the complex transition as compared to the last cycle of the first analysis. That decrease was, however, more significant in the case of all the irradiated samples than in the case of the initial sample. In result, the differences between the irradiated and the non-irradiated samples are easier detected after storage. The better differentiation between the amylose-lipid complex transition taking place in particular samples accompanied by the better reproducity were obtained in the case of ca. 50% suspensions as compared to ca. 20% suspensions submitted to the same treatment. The results are discussed in terms of the structural changes resulting in starch due to irradiation.

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[1] K Cieśla, E. Gwardys, T. Żółtowski, Starch/Starke, 43 (1991) 251.
[2] K.Cieśla, T. Żółtowski., R. Diduszko, Food Structure 12 (1993) 175.
[3] K Cieśla, A-C. Eliasson, Radiat. Phys. Chem 64 (2002) 137.
[4] K Cieśla, A-C. Eliasson, Radiat. Phys. Chem, 68 (2003) 933.
[5] K Cieśla, A-C. Eliasson, J. Therm. Anal. Cal 79 (2005) 19.