

Influence of selected non – starchy polysaccharide hydrocolloids on retrogradation of potato starch

Abstract

The aim of the thesis was to obtain the gels of potato starches distinguishing from each other with the amylose : amylopectin ratio, and to study the macrostructure and the degree of pasting as well as to study the course of retrogradation. Another purpose was to investigate the influence of the addition of selected non – starchy polysaccharide hydrocolloids (NPH), such as xanthan, guar and Arabic gums (both anionic and neutral gums) on the retrogradation process of the gels of potato starches with differentiated amylose and amylopectin content.

The materials were two normal potato starches (NPS1 and NPS2 – with a higher and lower amylose content, respectively) and a waxy potato starch (WPS). The materials were also non – starchy polysaccharide hydrocolloids, such as: xanthan (XG), guar (GG) and Arabic (GA) gums.

NHP were characterized with their dry matter content whereas in the starches dry matter, amylose, crude fat and total phosphorus contents were determined. Also water binding capacity of starches as well as their aqueous solubility at 75, 85 and 95° C were studied. The macrostructure studies included the measurements of the molecular weights of the granular starches and their 3% gels. An optical microscopy was used to investigate the degree of pasting of the starches. Pasting characteristics of aqueous suspensions of the starches without and with the addition of particular gums were determined.

The studies of the susceptibility of starches to retrogradation included mechanical spectra, hardness and syneresis measurements of the gels containing 4-6% of the starch without and with 0.05 and 0.20% addition of particular gums, obtained by pasting of the samples in a water bath, at 95° C, for 30 min. The content of resistant starch was also determined and X-ray and nuclear magnetic resonance measurements were performed in the samples containing 5% of each starch without and with 0.20% addition of the gums. Susceptibility to retrogradation for the freshly prepared gels and these stored within 90 days on cooling were measured.

Based on the results obtained, it was found that among granular starches normal potato starch NPS2 was characterized by the highest and waxy potato starch (WPS) – the lowest average molecular weights (M_n and M_w). In comparison to the granular starches, pasted samples of the NPS1 and NPS2 had lower average molecular weights and higher disparity

in the chain lengths. While WPS gels had higher average molecular weights and lower variation in chain lengths.

The pastes of all studied potato starches, both waxy and the normal ones, were characterized by the similar degree of pasting.

The changes of the viscoelastic properties, hardness and content of a resistant starch during storage of the gels of potato starches confirmed known from the literature overlap of starch retrogradation in two steps: (1) the retrogradation of amylose at the beginning of storage period and (2) the retrogradation of amylopectin (long-term), while the application of the other measuring methods did not allow to distinguish between these two phenomena.

The most essential changes of physicochemical properties of the gels, indicating the overlap of phenomenon of a starch retrogradation, could be observed between 30th and 90th day of the storage.

The amylose content has had a decisive influence on the susceptibility of potato starch gels to retrogradation, especially during the first two hours since the preparation of the samples, whereas the length of amylose chains played an important role in the initial phase of a refrigerated storage.

On prolonged storage of the samples (long-term retrogradation), the effect of the influence of the length of amylose chains on changes of the properties of the starch gels were partially neutralized.

Regardless the amylose content in the potato starches, the addition of xanthan and guar gums facilitated the formation of a three – dimensional gels network by amylose and systems of amylose with NPH, and thus accelerated the short-term retrogradation.

The influence of the GA on short-term retrogradation of the gels of studied starches was not quite clear. In some cases it caused changes of physicochemical properties, suggesting acceleration, and in others – inhibition of this phenomenon.

Xanthan gum reduced susceptibility to long-term retrogradation of the normal potato starch gels, whereas the greater impact on the reduction of this phenomenon was found in the case of the starch with the highest amylose content (NPS1) and with the 0.20% gum admixture.

The XG addition accelerated the long-term retrogradation of the WPS gels and the effect of this gum was the greater the higher was the concentration of both polysaccharides.

The influence of the GG on long-term retrogradation was similar to that of the XG, however particularly in the systems containing the starch with the highest amylose content (NPS1), its role in reducing susceptibility to retrogradation of amylopectin was lower.

The formation of weaker gels of the starches with gum Arabic at the beginning of the storage period contributed to the increased long-term retrogradation of both normal and waxy potato starches.

The addition of all tested NPH caused the reduction of syneresis of the majority gels during their long-term storage.

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