Discovery of a Remarkable Oscillatory Color Change in the Iodine Starch Reaction during the Early Stage of Acid Hydrolysis of Potato Starch

Hayashida , Momoko (School: Fukuoka Prefectural Meizen High School)
Shoyama , Hayato (School: Fukuoka Prefectural Meizen High School)
Yamamoto, Shintaro (School: Fukuoka Prefetual Meizen High School)

We noticed a strange oscillatory color change when observing the acid hydrolysis of potato starch using iodine. This change involved repeating deep and pale blue colors in the reaction sample during the early stages of hydrolysis. This oscillation is unlike the color variation described in several textbooks and is not observed with corn and rice starch. Upon further investigation, we found that this phenomenon is due to the structure of potato amylopectin, which consists of relatively long branched chains of α-glucose and is resistant to hydrolysis. This research represents the first study of this oscillatory change in the acid hydrolysis of starch monitored using iodine. We first confirmed that the absorbance of iodine coloration was linked to the average degree of polymerization ($\overline{(DP)}$) of the decomposed polymer. However, it is difficult to visualize chain length increasing during hydrolysis. To investigate this further, we conducted hydrolysis experiments using enzymatically debranched potato starch, and also potato amylose and potato amylopectin. No oscillatory phenomenon was observed with debranched starch or amylose but was observed with potato amylopectin, and thus we presume that the phenomenon is caused by the branched structure of amylopectin. Our measurements showed that the $\overline{(DP)}$ of branched-chain potato amylopectin is larger than that of corn amylopectin, and the rate of acid hydrolysis of potato amylopectin is slower than that of corn. The change is presumably due to the structure of potato amylopectin and its resistance to hydrolysis. These results suggest that a linear polysaccharide chain, which can form an iodine-amylose-like complex, may be produced intermittently by the cluster structure of amylopectin as hydrolysis proceeds.