Formation mechanism of starch nanocrystals from waxy rice starch and their separation using differential centrifugation

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Abstract: **【Objective】** In order to explore the formation mechanism of starch nanocrystals (SNC) during the whole hydrolysis process and proposed an interesting point on SNC separation by using differential centrifugation for collecting a suitable SNC product. **【Method】** Waxy rice starch was hydrolyzed by 3.16 M sulfuric acid solution preparing 15%wt suspension. The samples were collected at 1, 2, 3, 5 and 7 days by successive centrifugations and were freeze-dried. The hydrolysis kinetics, micromorphology, particle size distribution, zeta potential, molecular weight, chain length distribution, crystalline and thermal properties were evaluated. And differential centrifugation was employed in SNC separation. **【Result】** The hydrolysis process for waxy rice starch was divided into rapid hydrolysis stage in the initial 2 days and then slow hydrolysis stage. At hydrolysis of 2 days, the SNC product showed a nano-size of average diameter of 244 nm. With continuous hydrolysis, the crystalline degree and size and melting peak temperature and enthalpy increased. Meanwhile, the proportion of DP 6-12 chain declined, and the main proportion of DP 13-24 chains and molecular weight had insignificant change. Slow hydrolysis stage could be regarded as surface modification and gradual release of SNC. Furthermore, differential centrifugation displayed a good separation effect on the SNC product at hydrolysis of 5 days, because the product had small size and high charge density. **【Conclusion】** Waxy rice starch was used in SNC produce consisted of two steps, i.e., rapid hydrolysis stage within the initial 2 days and slow hydrolysis stage 2 days later. Slow hydrolysis stage was associated with the release and surface modification of SNC. The average size was reached at nanoscale after hydrolysis of 2 days. Differential centrifugation exhibited a good separation effect for SNC with small particle size and high charge density.

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