

Elucidation of Texture Improvement of Fermented Rice Noodles using Combined Rheological and Structural Analyses

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Fermented rice noodle is favored by people in China and Southeast Asia. To elucidate the effects of fermentation, combined rheological and structural analyses of gels made from fermented and nonfermented (control) rice flours with the same concentration as practical noodles were investigated. The study contains the following 4 parts.

I. Mechanical properties of fermented rice flour gel

Dynamic time sweep tests at 4 °C for 7 hr and frequency sweep tests at 25 °C on gels retrograded at 4 °C for 3 hr were performed. The steady increase of rigidity during time sweep test most likely reflected aggregation process of amylopectin. It was slower for fermented gel than the control, indicating that fermentation retarded gel retrogradation. Frequency sweep tests showed well-formed gel structure for both samples and more elastic and flexible for the fermented one.

II. Thermal properties modified by fermentation

Differential scanning calorimetry (DSC) measurements revealed that the gelatinization temperature of fermented rice flour shifted to lower temperature, but the crystalline structure of amylopectin remained unchanged. Existing protein affected on thermal properties of rice flour significantly. The gel made from fermented rice flour retrograded slower than nonfermented one.

III. Monitoring gel-forming process by dynamic viscoelasticity

Dynamic viscoelasticity in a temperature ramp sweep test showed the starch granule structure of fermented sample was more rigid and resistant to breakdown. The fermented rice flour formed gel earlier with a better gel structure for its lower value of loss tangent than that of the control. During aging, fermentation showed depression of the retrogradation rate. It could be say the rigidity of swollen starch granule and solubilised amylose are crucial factors for the rice noodle quality but the retrogradation of amylopectin might deteriorate the favorite texture of rice noodles. This may be the main reason why fermented rice noodles own a favorite texture.

IV. Amylose and rice type effects on a model system

Dynamic viscoelasticity showed a similar pattern with DSC endothermic curve for composite starch made from *Indica*, *Japonica* and waxy rice. *Indica* and waxy rice starch were incompatible and demonstrated individual rheological and thermal behaviors during heating. During cooling and aging, high amylose starch showed higher moduli and lower loss tangent values, as well as higher retrogradation rate. The starch gel made from *Japonica* rice starch showed slower retrogradation rate even if it has similar amylose content with *Indica* rice starch. It indicated that not only amylose content but also the origin of starch affect on the dynamic viscoelasticity of rice gel. Gels with higher amylose content showed less frequency dependence, and the magnitude of storage moduli was higher.

In conclusion, partial hydrolysis of amorphous region of amylopectin in starch granules might occur during fermentation, resulted in higher amylose content and released the internal stress of starch granule during swelling. It endowed rigid starch granule structure and resistance to breakdown, gave a better gel network and retarded the retrogradation of amylopectin. The textural properties of fermented rice noodles are thus improved.