Effect of Acetylation on the Properties of Corn Starch

by

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Summary

This project investigates the effect of acetylation on the properties of starch. Acetylation involves a chemical reaction of native starch with acetic anhydride in the presence of an alkaline solution. It is a prime method widely used in food industry to improve a starch's suitability for intended applications.

Previous studies have shown that chemical modification of starch through acetylation alters the structure of starch. The resultant acetylated starch normally possesses better stability at low temperature and a greater resistance to retrogradation when compared with its native form. Hence, acetylated forms of starch are widely used in baked, canned and frozen food products such as gravies, fruit pies, salad dressings and filled cakes.

Acetylation also improves the resistance of a starch to human digestive enzymes such as α-amylases. As a consequence, the acetylated starch acts as a "resistant starch" (RS) which is able to escape to the large bowel in a relatively undigested form where it may be fermented by microflora to produce short chain fatty acids (SCFAs). It has recently been discovered that SCFAs, especially butyrate, have potential roles in reducing risk factors associated with colorectal cancer.

This is resulting in increased efforts by food manufacturers to increase the amount of resistant starch in their starch-based food products to deliver this beneficial effect to their consumers. As well, there is growing interest in better understanding the characteristics and properties of acetylated starch that influence processing and product behaviour and performance such as swelling power, freeze-thaw stability, paste viscosity, and gelatinisation temperature.

In this study, a corn starch was acetylated with acetic anhydride under alkaline conditions to produce different degrees of substitution (DS). Experimental analyses were performed to investigate the effect of acetylation on a range of starch properties, including those mentioned above, and compare them with those of the native corn starch and a commercially available acetylated corn starch. This is the first time that the effect of acetylation on so many properties has been studied simultaneously for corn starch. It is also the first instance where the effect of different DS on starch properties has been investigated at the same time for a corn starch.

It was found that multiple treatments with acetic anhydride were required to achieve the desired range of DS: 0.03 to 0.21. No significant changes in shape, size or external appearance of the starch granules occurred following any of the treatments. As expected, the acetylated starches showed higher swelling power (e.g. increased from 15.2 to 27.9 g wet sediment/g initial dry starch), solubility (e.g. 8.5 to 17.4 % w/w), and pasting viscosity (e.g. 0.8 to 1.4 Pa.s), and better paste clarity (e.g. 1 to 12 % light transmittance) when compared with the corresponding native starch. Furthermore, acetylation caused reductions in pasting and thermal transition temperatures (e.g. decreased from 65 to 61°C), enthalpy of gelatinisation (e.g. 9.4 to 7.8 J/g), and retrogradation tendencies (e.g. 69 to 30 % separated water). It was observed that the changes in these properties were proportional to the DS achieved by acetylation. Some

of these changes behaved linearly whilst others displayed non-linear trends with DS achieved.

The data obtained, and the observations made in this study will be invaluable for other researchers in this field, and for food manufacturers wishing to modify corn starch-based foods by acetylation.

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