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The improvement of industrial corn gluten for non-food applications

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Objectives:

Maize is one of the major cereal crops in the world and one of its main uses is as animal feed. However, maize is also processed, principally by wet milling. The main purpose of wet milling is for starch production, during which insolubles proteins (maize gluten and zeins) are obtained. Maize gluten is mainly used as animal feed. It does not possess any functional properties that are essential for food and non-food applications (coatings, adhesives, surfactants, disposables, binders for paint and ink). However, based on its biochemical structure such as high hydrophobicity, low price and high abundance, maize gluten is a potentially interesting source for these applications. This project focused on the improvement of the functional properties of this protein through modification. In addition it investigated the effect of industrial processing of the proteins in the maize gluten, especially as far as their functional properties were concerned.

Activities and results:

There are two steps in the industrial process that can have an effect on the functionality of the proteins: steeping and the drying of the end product. During steeping the maize kernels are soaked in a dilute sulphuric acid solution at around 50 degrees C for 36 to 48 hrs. The effect of steeping temperature, steeping time and amount of metabisulfite was studied. The protein loss increased with steeping time, with up to 18.5% of the total protein in the kernel being lost after 48 hrs. The steeping temperature and amount of metabisulfite did not have any significant effect. Surprisingly a high loss of the zeins was also found during steeping. The biochemical properties of the maize gluten dried industrially and under milder conditions (vacuum drying) were also studied. It was concluded that drying did not have an effect on the gluten.

Another aim of the project was to improve the functionality of maize gluten. The first step in this task was to make maize gluten more soluble by modification. Several methods of modification were investigated. These included physical modification (using additives) and chemical modification (deamidation, hydrolysis and use of glyoxylic acid). When the maize gluten was physically modified in a mixture of guanidine and 1,4 dithioreitol it resulted in a nice waxy film. Unfortunately this film did not have any mechanical strength. Chemical modification by deamidation and reaction with glyoxylic acid did not improve the functionality. However, hydrolysis gave promising results and the process was optimised for pH and reaction time. Maize gluten was hydrolysed at different pH from 1 to 14 for 1, 3, 6 and 12 hrs. The functionality of the hydrolysed samples

was characterised according to molecular weight distribution and functional properties such as emulsifying, film and foam forming properties. No effect on the maize gluten was observed at pHs lower than 12. When maize gluten was hydrolysed at pH 12 for 12 hours, the functionality increased, resulting in film forming properties (low strength) and good emulsifying properties. When the maize gluten was hydrolysed at pH 14 for 1, 3, 6 and 12 hrs the samples had good emulsifying and also film forming properties.

Conclusions:

The emulsifying properties were better than for casein which are considered one of the best protein emulsifiers. Hydrolysing the samples at pH 14 for 12 hrs also produced a foam with high expansion and reasonable good stability.

Keywords: Corn, gluten, emulsifiers

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