On the nature of the Ca binding to the hull of nixtamalized corn grains

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Abstract

Corn hull is composed of cellulose, hemicelluloses and a minor fraction of lignin. Hemicelluloses are acidic polysaccharides which could explain the relatively large ability of the corn hull to retain Ca during the cooking of corn in a saturated solution of Ca(OH)2. In order to shed light in this sense the Ca binding to the hull of alkaline cooked corn grains was studied using EDS, pH titration, IR and 13C CP/MAS NMR techniques. For short cooking times, prior to hull degradation, Ca is retained in the corn grain according to the following order: hull > germ > endosperm. The acidic groups of hemicelluloses (mainly uronic acids) are the responsible for Ca retention in the corn hull. The amount of Ca retained by the hull approximately is 4 mg/g. On the alkaline cooking the hull is progressively degraded and loses its ability to retain Ca because the hemicelluloses fraction passes to the cooking liquor.

Keywords: Tortilla; Corn hull; Nixtamalization; Hemicelluloses; Infrared; 13C CP/MAS NMR

1. Introduction

In Mexico and Guatemala corn is mainly consumed as Tortillas. Tortillas are prepared from mass or flours obtained through an alkaline cooking and steeping of corn grains in a saturated solution of Ca(OH)2, process known as nixtamalization, which is used in this region from prehispanic times. The traditional process was industrialized several decades ago but preserving the alkaline cooking of the corn grains (Pflugfelder, Rooney, & Waniska, 1988). This treatment is oriented to remove the corn hull, to make corn proteins available and to incorporate Ca to the cooked grains, increasing the nutritional levels of the mass or flours elaborated from nixtamalized corn (Trejo-González, Feria-Morales, & Wild-Altamirano, 1983). Approximately 50% of Ca intake in Mexico, mainly in rural regions, is provided by Tortillas and other products elaborated from nixtamalized corn (Serna-Saldivar, Gomez, & Wild-Altamirano, 1983). It is accepted that of the total Ca employed in nixtamalization only a small fraction is retained in the grain during the cooking and resting periods (Trejo-González et al., 1983). In the germ Ca is found as salts of fatty acids, due to a partial saponification of its fats during the alkaline cooking, while in endosperm it is forming inclusion compounds of these salts within the amylose helical structure (Reguera, Yee-Madeira, Fernández, & Sánchez-Sinencio, 2000). Little attention has been given to the possible retention of Ca by the corn hull (pericarp) and on its state in this part of the grain, although, as will be discussed latter, the presence there of species capable of bind Ca. The aim of the present contribution is to carry out a systematic study on the Ca binding to the corn hull. This process leads to a progressive...