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Application of photoacoustic spectroscopy to the optical study of pigments in corn pericarp: spectral separation of optical absorption centres

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Abstract. The optical absorption centres in corn pericarp biopolymers have been studied by photoacoustic spectroscopy and the phase-resolved technique. The results show that the optical absorption spectra of these samples are formed by the superposition of two absorption bands, one of these corresponding to the cellulose of the epidermis and the other to o-glucoside pigments of flavonoid type which are bound to hemicellulose sugars. A spatial separation was obtained of the materials responsible for these absorption bands as a function of the $Ca(OH)_2$ concentration used in the alkaline cooking process which is the result of hemicellulose dissolution in these biopolymers.

1 Introduction

Before tasting food, the consumer is essentially attracted by two factors: the smell and the appearance including the colour of the product. The chemical changes during food processing are sometimes good but most of the time some of the product quality is lost. Remarkable changes in pigmentation can lead to a rejection of the product by the consumer. The identification of food pigments and the understanding of the mechanism that takes place in storage and in processing therefore have special importance from both scientific and economic points of view (Aurand and Woods 1976; Simpson 1985).

Products cooked in an alkaline medium (nixtamalised products) play a fundamental role in the diet of the people in Latin America and in the south of the United States. Tortillas give 70% of the calories and half of the portion of protein in most of the Mexican population (Paredes López and Saharopoulos 1982). Understanding of the physical and chemical changes in corn grain parts that occur in the nixtamalisation process is fundamental for the improvement of the product and the optimisation of its processing. The addition of pericarp in the production of corn-nixtamalised flour determines the final product quality, which means colour, texture, flavour, and smell (Khan et al 1980; Choto et al 1985). However, there are no data on the physical and chemical properties of pericarp after the nixtamalisation process. In comparison with the studies on starch properties and transformations (Robles et al 1988; Gómez et al 1991; Ziegler et al 1993; Bryant and Hamaker 1997), research on pericarp is limited (Wolf et al 1952; Muñoz Hernández 1998; Cruz Orea et al 1999).

Photoacoustic spectroscopy (PAS) is one of the most convenient techniques for non-destructive studies in materials (Rosencwaig 1990; Mandelis and Hess 1997) and it has fewer obstacles than conventional optical spectroscopy. In PAS, the heat, generated by