



RETROGRADED STARCH IDENTIFICATION BY FTIR AND NMR CP/MAS-13C SPECTROSCOPY IN AN INSTANT CORN DRINK "CHAMPURRADO".

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Introduction. Atole, prehispanic beverage consumed in Mexico. The atole made with nixtamalized maize flour added with cocoa is called "Champurrado". The nixtamalization, elaboration and storage of atole cause several changes on the starch structure, resulting in an increased crystallinity and therefore an important content of resistant starch. The retrograded starch is considered as dietary fiber. The objective of this study was to develop an instant beverage of traditional foods like "Champurrado", and identification the presence of retrograded starch by FTIR and CP/MAS-13CNMR spectroscopy.

Methods. The characterization of the instant beverage was assessed determined their physicochemical properties, according to AOAC, (1985) methods. Determination of amount of amino acids was assessed using Simpson R.J. et al, 1976, method. Analysis of Ca, Fe and Mg were performed, using an atomic absorption. Microbiological Analysis for aerobic bacteria in plaque (NOM-092), total coliforms (NOM-113), fungi, yeasts (NOM-111). Resistant starch (AR) associated to dietary fiber content (RS3) was prepared according to Mora-Escobedo, 2004. Identification of AR was using IR and CP/MAS-13CNMR spectroscopy.

Results. Table 1 showed the composition chemical of instantaneous beverage. When comparing the proportion of amino acids, with respect to the FAO/WHO, (1991) pattern, cannot be recommended as an important source of them due to low amount especially of tryptophan. Microbiological testing complies with NOM-186-SSA1 NOM-147-SSA1-1996 for fungi and yeast. Not microorganisms were found.

Analysis of infrared spectra for instant beverage (fig. 1) showed characteristic bands of native maize starch, these bands originate mainly from the vibrational modes of amylose and amylopectin, the bands at 1022 and 850 cm^{-1} are sensitive to changes in crystallinity of starches, them, the intensity of band at 1022 cm^{-1} determine the orientation in intermolecular H-bonding of CH and CH_2 in CH_2OH (Van Soest J.J.G et al., 1994, Smits, A et al., 1998, García-Rosas et al., 2009). In this case, it observed a changes at the bands of 3358, 2924, 2854, 1741, 1647 cm^{-1} , These bands are associate to retrogradation process and crystallization of starch. In the spectra of CPMAS 13C for flour of the instant drinks it was observed three dominant signals into 103 ppm (C-1) for α -glucose carbon chemical shift for starch have been identified between

106-96 ppm, in 70-73 ppm for C-2, C-3 and C-5, in 79-83 ppm for C-4, and 59-62 ppm for C-6 (Primo-Martin et al 2007). Three distinct polymorphs of amylose exist and are referred to as the A-, B- and V- forms with the V- type only being formed in presence of a complexing ligand (Snape et al 1998).

Table 1. Characterization of the instant beverage

Parameters	Traditional ($\text{g} \cdot 100 \text{g}^{-1}$)	Instant ($\text{g} \cdot 100 \text{g}^{-1}$)
Density($\text{g} \cdot \text{L}^{-1}$)	1.09 \pm 0.009	1.03 \pm 0.018
Viscosity ($\text{Kg} \cdot \text{m}^{-1} \cdot \text{s}^{-1}$)	3.01 \pm 0.017	3.2 \pm 0.016
pH	7.44 \pm 0.001	6.61 \pm 0.157
Moisture	84.29 \pm 0.050	1.53 \pm 0.101
Ash*	1.23 \pm 0.047	1.94 \pm 0.093
Fat*	6.02 \pm 0.063	3.2 \pm 0.084
Protein*	5.15 \pm 0.804	7.67 \pm 0.157
Total Dietary Fiber*	3.29 \pm 0.847	7.04 \pm 0.441
Carbohydrates*	NA	38.6
Ca	NA	0.16
Fe	NA	0.01
Mg	NA	0.01

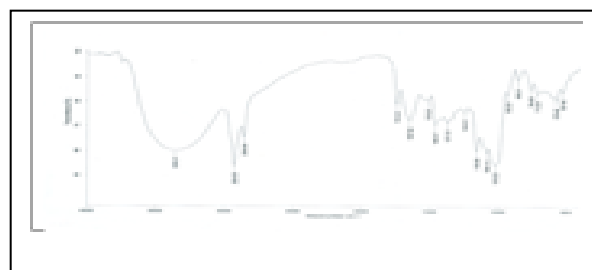


Fig.1 IR-spectra of instant beverage flour

Conclusions. It was obtained a formulation for an instant beverage "champurrado", traditional pre-Hispanic food. The IR and CPMAS 13C results indicate that the principal component in this beverage is starch as native and retrograded, with some crystallinity due to retrogradation of starch during nixtamalization process.

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