Development of a point-of-use, iron fortification technology of nixtamalized corn masa for rural communities in Central America

Pablo C. Torres-Aguilar1, Chen Chen2, Brian Jacobson2, Youngsoo Lee2, Juan E. Andrade1,2

1Division of Nutritional Sciences, 1,2Department of Food Science and Human Nutrition, College of ACES, University of Illinois at Urbana-Champaign

Abstract

Iron deficiency anemia (IDA) is a major health concern. Fortification of nixtamalized corn (NC) for tortillas at the point of wet grinding could be an effective strategy against IDA in rural Central America. Process of making iron containing extruded pellets (IEPs) and their addition to NC is presented. IEPs will be added to NC previously grinding at local milling facilities. Welly Puffing extruder set at a feed rate of 60 g/min was used to create brown rice:corn grits (1:1, w/w) pellets. Two chelated Fe sources were evaluated, ferric FeNaEDTA (FeNaEDTA) and ferrous bisglycinate (FeBG). Fe solutions were pumped (2 mL/min) to target levels, 0.4 mg/g or 1 mg/g pellet, respectively. Process stability was evaluated from 0.5 to 19 min from Fe addition. IEPs were added to NC at different amounts, 12.5, 25, 50 g pellet/kg NC, resulting in target levels of 8.2, 16.3 and 32.6 (FeBG) and 3.9, 7.8, 15.65 (FeNaEDTA) mg Fe/kg of masa. Fe recoveries in IEPs upon processing were 78.3±5% and 65.3±3.8 % for FeNaEDTA and FeBG, respectively; with homogenous distribution for both iron sources after 14 min of processing (Brown and Forsythe P>0.1). IEPs dimensions (l×ø) from both sources were similar, 16.7±1.1 × 11.4±0.9 mm. Fe source changed color in pellets, but it did not affect masa color. Iron distributed well in NC masa fortified with both IEPs. Our technology shows the feasibility of Fe fortification at the point of NC grinding using extruded materials.

Introduction

Micronutrient deficiencies are persistent among rural communities in Central America. Factors such as limited income, job seasonality, dependence on staple diets, and low diet diversity are causes of this situation. Dietary patterns are characterized by low consumption of animal products, fruits and vegetables and fortified foods. Furthermore, consumption of nutrient inhibitors such as phenolic compounds, tannins and phytates adds to the problem. During dry season families heavily depend on self-produced staples (corn and beans). Beans as refined paste or boiled and corn in the form of masa (i.e., tortillas). A great majority of people use local milling facilities (wet milling) for masa processing. We contend that these wet milling facilities could be an appropriate venue to add sources of highly bioavailable iron, among other micronutrients, to local diets.

Hypothesis

Through the creation of a point-of-use fortification technology we can incorporate and deliver a uniform quota of chelated iron into nixtamalized corn masa (NCM) via a traditional wet milling process.

Aims

- Design an extrusion process and the product thereof for the incorporation of Fe into NCM
- Optimize Fe incorporation and redistribution in NCM
- Determine rheological and color changes in Fe fortified NCM

Changes in masa texture after storage

Effect of FeNaEDTA on NCM texture during the point of wet grinding could be an effective strategy against IDA in rural Central America.

Method

Samples were ashed (575 °C) and Fe measured using microwave plasma atomic emission spectrometer (MP-AES). Results were compared to high purity standards for reliability.

Results

Stability of Fe in Extruded Pellet overtime

Peel pellet % recovery

(mg Fe/g pellet)

FeNaEDTA- 78%

Ferrous Bisglycinate- 65%

Recovery of Fe after fortification of NCM

Recovery in pellets for both iron chelates formulations after extrusion process was adequate, but requires further optimization.

Conclusions

- A uniform and stable fortified pellet (corn:rice, 1:1 w/w) was obtained using a Welly puffly extruder and a fluid delivery strategy.
- Recovery in pellets for both iron chelates formulations after extrusion process was adequate, but requires further optimization.
- Redistribution in NCM was not homogeneous for both chelated formulations. However, 25 g ferrous bisglycinate was the most adequate (96%; CV=35%).
- Addition of different levels of fortified pellet (both formulations) did not modify NCM characteristics (texture and color) after 8 h storage at RT.

Acknowledgments

This work was partially funded by Hatch Project # ILLU-698-319.