ABSTRACT

The sub-Saharan Africa population’s diet is mainly based on cereals and legumes. Legumes are sources of good quality of protein, carbohydrates, various minerals and vitamins [1]. Having less expensive proteins is an increasing demand across the world and particularly in under-developed countries [2]. Cowpea is one of the main legumes consumed in Senegal which annual production increase from 99924 tons in 2017 to 117784 tons in 2018 [3]. The protein content of cowpea is between 18 and 35 g/100 g [1,4,5]. However, the presence of several antinutritional factors (ANFs) can limit the nutritional values of this legume by reducing the bioavailability of some essential minerals. Phytic acid (phytate; myo-inositol 1,2,3,4,5,6-hexakisphosphate) is one of the most naturally occurring constituent of plant seeds, roots, tubers, some fruits and vegetables. It acts as a storage form of phosphate [6]. Specifically, phytic acid is known to build complexes with essential dietary minerals such as calcium, zinc, iron and magnesium, making those biologically unavailable for absorption. Phytic acid can also chelate vitamins and potentially contribute to their deficiency and to disease pellagra [7]. In cowpeas, phytate content is 559 mg/100g DM [8]. Through previous research, several dipping methods are shown to reduce the phytate content in legume seeds [9,10,11]. Among those methods, soaking, sprouting, fermentation, extrusion cooking and steam pre-cooking are demonstrated [9,11,12]. Soaking cowpea in water during 24 hours lost 8%-9% of phytate content [13]. A better reduction of 22.4%-23.7% on two varieties of cowpea after 24 hours of soaking has been obtained [13]. Unfortunately, these techniques can remove or reduce some recommended components which may be required to enhance nutritional quality [14,15].

Thus, this study aims to determine optimal conditions which either reduces phytate or preserves nutrients in cowpea.

MATERIALS AND METHODS

Sample Preparation for Analysis

Beyond soaking, cowpea cowpea samples were dried at 75°C in an oven during 24 hours. They were finely ground to a fine powder (particle size of 0.5 mm) using a laboratory mill 3100 (Perten instruments) in order to be analyzed.

Phytylic Acid Quantification

Phytic acid content of cowpea was determined using Latta and Eskin [15] and Vaintraub et al. [16] methods with some modifications. 1 g of each sample was weighed and immersed in 20 mL of water with 0.4 mL of 0.1 M acetic acid solution in 24 tubes. 40 mL of 2.4% concentrated HCl was added to each tube, at room temperature. Tubes were vortexed during 2 hours every 10 min for 15s. After 2 hours, the tubes were centrifuged during 30 min at 3000 rpm. The clear supernatant was used for the phytate quantification. 5 mL of Wale reagent (0.03% solution of FeCl3 6H2O containing 0.3% sulfosalicylic acid in water) was added in 15 mL of the supernatant; the mixture was vortexed for 5s. The new supernatant was then transferred in a cell to read absorbance at 550 nm. Distilled water was used as a blank. Phytate content were determined in triplicate.

Zinc and Iron Quantification

Minerals content were determined in triplicate. Zinc and Iron contents were determined by atomic absorption spectrophotometry after mineralization at 550°C for 4 hours. Hydrochloric acid was added to the ash obtained and then evaporated to dryness. The residue was dissolved in Nitric acid and this solution was analysed by Atomic Absorption Spectrophotometer (AAS) using the technique of flame [17].

RESULTS AND DISCUSSION

The results presented in figures show that the phytate content of soaked cowpea cowpea decreased with the acidity of the soaking solution but also the treatment time. For minerals, results reveal that soaking water does not significantly reduce neither zinc nor iron. Acetic acid solutions induced a significant removal of zinc but not for iron. The best reduction of phytate content (41.48%) is obtained with acetic acid 2% within 24 hours.

Acetic acid is a weak dietary acid which is found in commercial vinegar at 6% ordinary used in households. Treatments were carried out by soaking cowpea in water or acetic acid. The molar ratio of 1.375 (grain solution, at room temperature (25°C)). Four times soaking were applied: 4, 8, 16 and 24 hours. The pH of tap water was 7.0 and of the 1 and 2% acetic acid solutions were 4.0 and 3.0 respectively. The samples obtained were named NiT (nietre not treated), NE (nietre soaked in water), NAC1 (nietre soaked in 1% and 2% acetic acid respectively).

Soaking is treatment which is commonly used to prepare cowpea in household. The study reveals that soaking promotes significant phytate reduction in acetic acid solution which can be compare to vinegar. This treatment reduced zinc and iron but did not modified seriously their bioavailability. Then the method can be adopted in households.

CONCLUSIONS

Improving Nutritional Quality of Cowpea (Vigna unguiculata) by Soaking Process

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