DOI : https://doi.org/10.47485/2834-7854.1022
Review Article
ISSN 2834-7854

Journal of Nutrition Food Science and Technology

Effect of Soaking in Neutral and Acidic Media on The Phytate Content of Souna Millet

Mamadou Salif Sow[1, 2*], Djibril Diallo[1], Abdou Diouf[1], Seynabou Momar Fall[1], Mady Cissé[2]

1Institut de Technologie Alimentaire (ITA), Route des Pères Maristes, BP 2756 Hann, Dakar, Sénégal.

2Ecole Supérieure Polytechnique, Université Cheikh Anta Diop de Dakar (UCAD), BP 5005 Fann, Dakar, Sénégal.

***Correspondence author**
Mamadou Salif Sow
Institut de Technologie Alimentaire (ITA),
Route des Pères Maristes, BP 2756 Hann, Dakar,
Sénégal.

Ecole Supérieure Polytechnique,
Université Cheikh Anta Diop de Dakar (UCAD),
BP 5005 Fann, Dakar, Sénégal.

Submitted : 14 Feb 2022 ; Published : 11 Mar 2023

Citation: Sow, M. S. *et al* (2023). Effect of Soaking in Neutral and Acidic Media on The Phytate Content of Souna Millet. J N food sci tech, 4(1):1-4. DOI : https://doi.org/10.47485/2834-7854.1022

Abstract

The aim of the study was to determine the effect of soaking time and acidity of the soaking solution on millet phytate content.

The results shown that the sample that was not soaked contained a phytate content of 834.54 mg/100g dry matter. The study revealed that soaking in water for 8 hours resulted in a significant reduction of phytates. This reduction was 5.4%. When the medium was acidified to a concentration of 1% and then 2%, the phytate reduction rates increased significantly to 16.37% and 16.81% respectively. For the same solutions of the same concentration but with a soaking time of 16 hours, the reduction rates are 8.2% in water, 24.66% for the 1% acid solution and 30.98% for a concentration of 2%. The results obtained in this study therefore shown that soaking with a 2% concentration solution is more effective in reducing phytate levels in millet.

Keywords : millet, soaking, acid, phytates.

Introduction

Cereals are the staple food in Senegal and in many West African countries. Millet, along with rice, is the staple food and is consumed in the form of paste, porridge, couscous or patties, broken rice, etc.

In these countries, the food and nutritional situation of the populations is marked by protein-energy malnutrition in children aged 0 to 5 years and micronutrient deficiencies that affect all strata of the population (Demographic and Health Survey, 2017).

In Africa and India, millet is used for human consumption (Abdalla et al., 1998).

The content of essential amino acids, especially tryptophan, is higher in millet than in other cereals. Millet is also a good source of B vitamins, particularly thiamine and niacin, whose levels in the finished products are especially related to the technological treatments applied; it is, however, low in calcium but has a significant iron content (Lestienne, 2004).

However, this iron is usually chelated by phytic acid. Indeed, the bioavailability of a nutrient depends both on factors intrinsic to the diet and on physiological factors specific to each individual. Cereals, such as millet, are rich in anti-nutritional factors, in particular phytic acid IP6 (myo-inositol (Demographic and Health Survey, 2017), (Abdalla et al., 1998), (Tankoano, 2017), (Lestienne, 2004), (Kaur et al., 2015), (Kim et al., 2003) -hexakis phosphate), which form insoluble complexes with minerals such as iron, which are generally stable during digestion and therefore not absorbable (Lestienne, 2004). To improve the bioavailability of minerals, especially iron, it is therefore important to use processing methods that reduce phytates in millet. It has been shown that the main traditional methods used to reduce anti-nutrients and improve the bioavailability of minerals are: soaking, dehulling, cooking, germination and fermentation (Kaur et al., 2015), (Kim et al., 2003), (Larsson & Sandberg, 1992). Soaking is the most common method used by grain processing units. Moreover, soaking in acidic medium is more efficient since the pH of the soaking water was between 4.5 and 5, which is an optimal condition for phytase activity (Egli et al., 2002).

Thus the objective of this study was to determine the combined effect of soaking time and acidity of the soaking solution on the phytate content of millet.

Material and Methods

Plant material

The plant material used in this study was 10 kg of millet purchased at the police market (Dakar parcelles assainies unit 22). This millet is the souna variety, better known as penicillary millet, but its geographical origin is unknown.

Methods

Technological treatment

This concerns all technological processes put in place to ensure the successful implementation of the chosen phytate reduction operation.

Calibration and dry cleaning

The millet was dry cleaned by winnowing to remove impurities such as sand and stones. The cleaned millet was then sieved to separate large and small millet through a succession of sieves of 1.5 mm and 1 mm diameter respectively. The first sieving allows the removal of fine particles such as sand and dust.

Wet cleaning

Coarse millet with a particle size of more than 1.5 mm was used for further testing. This millet was soaked in a bleach solution for 10 minutes and then rinsed with tap water. This rinsing operation is carried out three times in a row in order to eliminate traces of bleach.

Soaking

Soaking was carried out in plastic pots. Thus, three sets of tests were carried out for each of the following dipping modes:

- Three (3) samples for Soaking of 100 g millet in 300 ml of drinking water soaking solution;
- Three (3) samples for Soaking 100 g of millet in 300 ml of 1% acidic soaking solution;
- Three (3) samples for Soaking 100 g of millet in 300 ml of 1% acidic soaking solution.

For each test, three replicates were carried out and three times were retained, including 8 h and 16 h. Acetic acid was used.

Drying

To reduce moisture, the millet samples were then sun-dried for two days to a moisture content of between 9 and 11%. The samples were rinsed and well spread out on a drying tray and then placed in the sun. The drying process is fully solar for a period of 4 hours. The sample was stirred every 30 minutes to ensure that the moisture content of all the grains was uniform.

Milling

The samples of millet grains treated by the different methods and three samples of untreated (raw) millet grains, but dry-cleaned and graded like the treated grains, serving as a control, were finely ground using a PERTEN type 3100 mill.

Analytical Methods

Determination of Phytates

Phytate levels were determined by the method described by Latta and Eskin (1980) and Vaintraub et al. (1988).

Determination of water content

For each sample, we then calculated the dry matter contents from the moisture contents determined according to the (Association Of official Analytical Chemists (AOAC), 2007) Method.

Statistical Analysis

XLSTAT 6.1.9 software was used. The comparison of the difference in phytate and mineral content between the different samples was determined. A significant difference between the samples was observed for $p < 0.05$.

Results and Discussion

Figure 1 below shows the variation of phytate content in millet according to the acidity of the solution for an 8 hour soaking

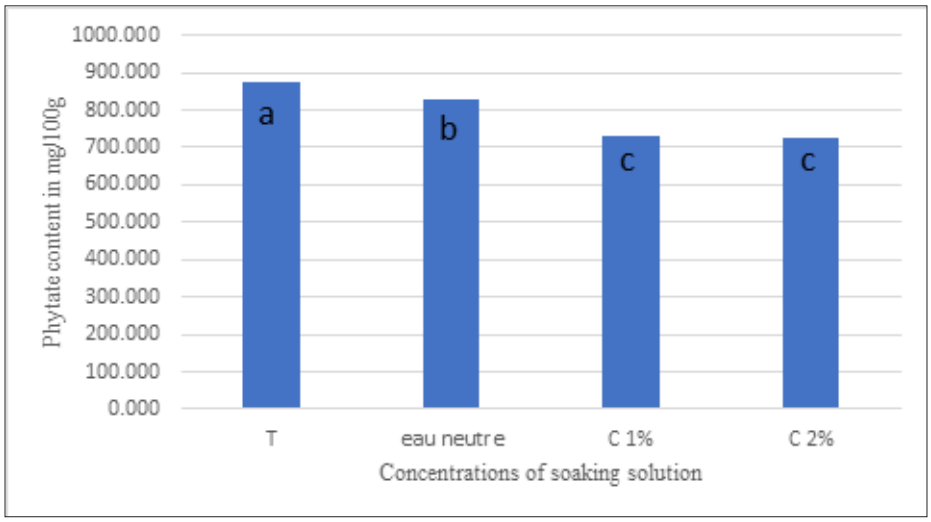

Figure 1: Effect of the acidity of the solution for 8 hours of soaking

The control sample that did not undergo any soaking contained 834.54 mg/100g dry matter. Abdalla et al. (1998), for example, studied the phytate content of ten Sudanese millet genotypes and found values ranging from 0.35 to 0.80 g/100g (i.e. 350-800 mg/100g), indicating a strong varietal effect. Hoosney et al. (1984), on the other hand, determined the phytate content of different genotypes grown in two geographical areas.

They found levels ranging from 0.18 to 0.27 g/100 g in the first area and from 0.21 to 0.31 g/100 g in the second area, thus highlighting the determining effect of genetic and environmental factors on phytate levels. Buerkert et al. (1998) showed that the application of phosphorus during millet cultivation increased the phytic acid content of the grains by 25-29%.

Figure 1 shows that soaking in water for eight (8) hours leads to a significant reduction in phytates from 834.54 mg/100g to 826.01 mg/100g (a reduction of 5.4%). When the medium is acidified to a concentration of 1% and then 2%, the reduction rates of phytates increase significantly to 16.37% and 16.81% respectively.

Figure 2 shows the variation of phytate content in millet according to the acidity of the solution for a 16-hour soaking.

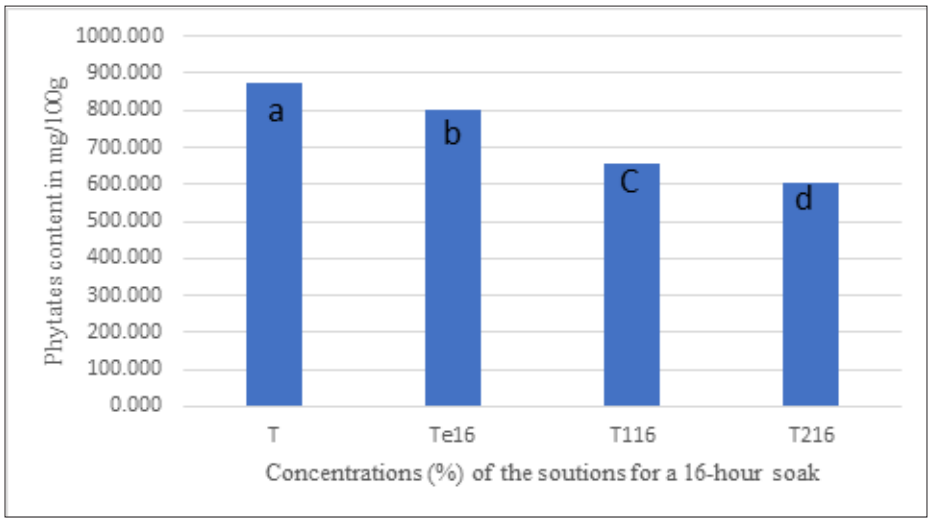

Figure 2: Effect of the acidity of the solution for a 16 hours soaking

The analysis of the results shows a great variability on the phytate content.

In figure 2, we see that for the same soaking solutions but with a soaking time of sixteen (16) hours, the reduction rates are 8.2% in water, 24.66% for the 1% acid solution and 30.98% for a 2% concentration. The results obtained show that soaking with a 2% concentration solution is more effective.

Conclusion

Traditional water soaking, used by millet processing units, leads to a reduction of phytates in souna millet produced in Senegal. The rate of reduction increases when the soaking time is long as it is 8.2% after 16 hours of soaking against 5.4% after 04 hours of soaking. However, to have very significant phytate reduction rates, it is important to acidify the soaking solutions. Indeed, the 16 hours of soaking with water which gave 8.2% reduction of phytates, succeed in reducing them by 30.98% when the soaking solution is acidified to 2%. The analysis of this result shows that the reduction of phyates is even greater by combining long soaking time and higher acid concentration.

References

1. Demographic and Health Survey 2017 conducted by the ANSD and the Senegalese Malnutrition Control Unit.
2. Abdalla, A., Tinay, A., Mohamed, B., & Abdalla, A. (1998). Effect of traditional processes on phytate and mineral content of pearl millet. *Food Chemistry, 63*(1), 79–84. https://doi.org/10.1016/S0308-8146(97)00194-5.
3. Tankoano, A., Diop, M. B., Sawadogo-lingani, H., kaoré, D., & Savadogo, A. (2017). Les aspects technologiques, microbiologiques et nutritionnels des aliments fermentes a base de lait et de mil en Afrique de l'ouest. *International Journal of Advanced Research, 5*(8), 2320-5407. http://dx.doi.org/10.21474/IJAR01/5211
4. Lestienne, I. (2004). *Contribution to the study of the bioavailability of iron and zinc in millet grain and conditions for improvement in supplementary feeds.* Montpellier: Université Montpellier II.
5. Kaur, S., Sharma, S., Singh, B., & Dar, B. N. (2015). Effect of extrusion variables (temperature, moisture) on the antinutritient components of cereals brans. *J Food Sci Technolo, 5*(3), 1670-6. DOI : https://doi.org/10.1007/s13197-013-1118-4
6. Kim, H. W., Kim, Y. O., Lee, J. H., Kim, K. K., & Kim, Y. J. (2003). Isolation and characterization of a phytase with improved properties from Citrobacter braakii. *Biotechnol Lett, 25*(15), 1231-4. DOI : https://doi.org/10.1023/a:1025020309596

7. Larsson, M. & Sandberg, A. S. (1992). Phytate reduction in oats during malting. *J. Food Sci., 57*(4), 994-997. DOI : https://doi.org/10.1111/j.1365-2621.1992.tb14340.x
8. Egli, I., Davidsson, L., Juillerat, M. A., Barclay, D., & Hurrell, R. F. (2002). The Influence of Soaking and Germination on the Phytase Activity and Phytic Acid Content of Grains and Seeds Potentially Useful for Complementary Feeding. *JOURNAL OF FOOD SCIENCE, 69*(9), 3484-3488. DOI : https://doi.org/10.1111/j.1365-2621.2002.tb09609.x
9. Latta, M. & Eskin M. (1980). A simple and rapid colorimetric method for phytate determination. *Journal of Agricultural and Food Chemistry, 28*(6), 1313-1315. DOI :https://doi.org/10.1021/jf60232a049
10. Vaintraub I. A. & Lapteva N. A. (1988). Colorimetric determination of phytate in unpurified extracts of seeds and the products of their processing. *Analytical Biochemistry, 175*(1), 227-230. DOI : https://doi.org/10.1016/0003-2697(88)90382-x
11. AOAC. (2007). *Association Of official Analytical Chemists*. Official Methods of Analysis, 19th Edition Washington, DC USA. https://www.aoac.org/official-methods-of-analysis-21st-edition-2019/.
12. Hoseney, R. C., Varriano-Marston, E., Zeleznak, K., & Simwemba, C. (1984). Certain B vitamin and phytic acid contents of pearl millet [Pennisetum americanum (L.) Leeke]. *Journal of Agricultural and Food Chemistry, 32*(1), 31-34. DOI : https://doi.org/10.1021/jf00121a008
13. Buerkert, A., Haake, C., Ruckwied, M., & Marschner, H. (1998). Phosphorus application affects the nutritional quality of millet grain in the Sahel. *Field Crops Research, 57*(2), 223-235. DOI : https://doi.org/10.1016/S0378-4290(97)00136-6