Soaking and Dehulling Failed to Improve Zinc Bioavailability from Experimentally Processed Dibou, a Thick Sorghum Porridge

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INTRODUCTION

Zinc deficiency is a major public health problem in developing countries. High prevalence might be caused mainly by cereal consumption because of their content of absorption inhibitors. Brown et al. (2001) estimated that about 68 % of Sub-Saharan African population is at risk of low dietary Zn intake. Studies in Northern Benin revealed that cereals were the main products consumed in all seasons and about 95 % of the ingested protein and Fe were of plant origin (Ategbo 1993). This food pattern might be associated with low Zn bioavailability and might partially explain the reported prevalence of stunting in 25 to 40 % of Beninese children. This study was designed to investigate household strategies to improve Zn bioavailability in dibou, a thick sorghum porridge and the most common cereal food in Northern Benin.

The objective was to measure the effects of reducing phytate and polyphenol contents on Zn solubility and estimated Zn bioavailability in experimentally processed dibou.

METHODS

In vitro Zn solubility was measured in dibou powders following Glahn et al. (1998) and Kiers et al. (2000). About 20 kg of grain from a local sorghum cultivar (Chabicouman) were purchased at a local market in Northern Benin. Five different flours were obtained from it using various processing (Fig. 1). Subsequently, 500 g of flour were used to prepare dibou in laboratory controlled conditions. Dibous were freeze-dried and reduced to powders. Phytate (IP6) was measured in flours and dibou powders by HPLC. Total phenolic compounds (PC) were determined using the Folin- Ciocalteu's method adapted to a 96 well plate assay. Zn was measured by Inductively Coupled Plasma - Atomic Emission Spectrometry (ICP-AES).

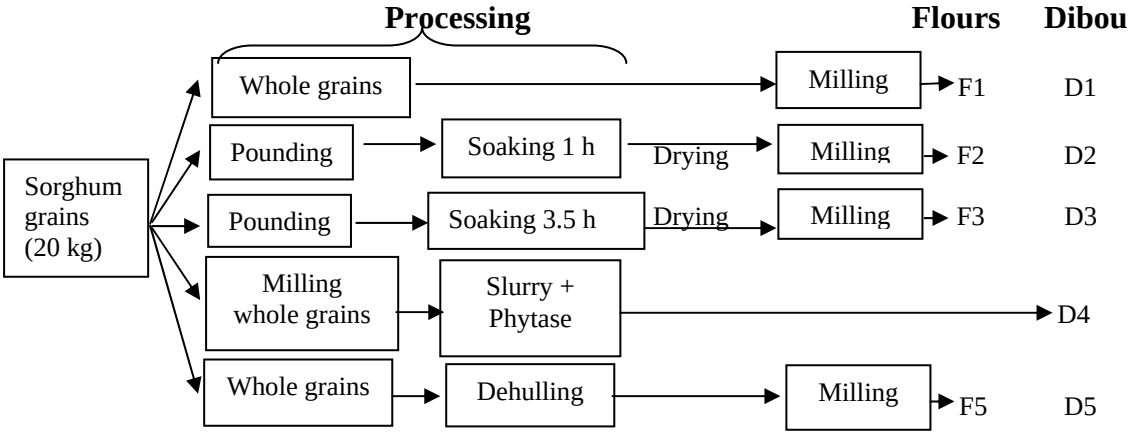

Fig. 1. Flow chart for the preparation of different dibous, F = flour ; D = dibou.

RESULTS AND DISCUSSION

Dehulling resulted in higher Zn and phytate losses compared to soaking of pounded grains. Losses of PC due to dehulling or soaking of pounded grains were similar (Table 1). In vitro solubility of Zn responded similarly and independently of the digestion method (Fig. 2). However, the Glahn method gave rather high values and might have overestimated.

Table 1. Effect of various processing on phytate, PC and Zn contents of dibou powders.

Dibou type	Zinc		Phytate (IP6)		PC	
	content	retention*	content	retention*	content	retention*
	(mg/100g)	(%)	(mg/100g)	(%)	(g/100g)	(%)
Whole grain	2.5	94.3	1177	101.2	0.26	33.7
Pounded, soaked, 1h	2.5	94.3	838	72.0	0.44	57.1
Pounded, soaked, 3.5 h	2.5	94.3	881	75.8	0.47	61.0
Dephytinised	2.8	105.7	322	27.7	1.00	129.9
Dehulled	1.6	60.4	741	63.7	0.45	58.4

*Retention is calculated as the proportion of element in dibou powder compared to unprocessed whole grain flour.

Degradation of native phytate using exogenous phytase reduced phytate contents by 73 %. Dehulling reduced phytate content by 37 %. Lestienne et al. (2005) reported similar results in pearl millet. Zinc solubility was highest in dephytinised grains followed by dehulled grains. Phytate/Zn molar ratios calculated to estimate Zn bioavailability in dephytinised and dehulled dibous were 11.4 and 46.7, respectively, suggesting poor Zn bioavailability. Phytate and PC residues in processed dibou powders obtained by soaking and dehulling grains may still have been too high to increase Zn bioavailability.

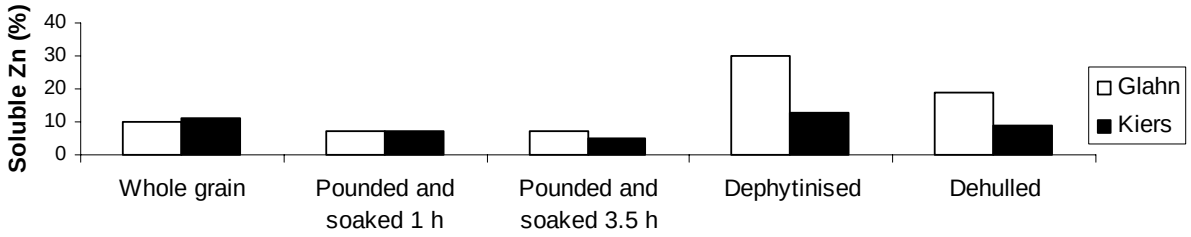

Fig. 2. In vitro solubility of zinc from dibou powders using Glahn and Kies methods

CONCLUSIONS

Phytate and PC reduction achieved by soaking and dehulling did not increase Zn bioavailability. More research is needed to study the combination of varieties with low level of inhibitors and to study processing that will allow adequate degradation of phytate and PC to levels that increase Zn bioavailability. Other strategies such as fortification at the household level and biofortification should also be explored.

ACKNOWLEDGEMENTS

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REFERENCES

Ategbo, E.A.D. (1993) Food and nutrition insecurity in northern Benin: impact on growth performance of children and on year to year nutritional status of adult. PhD thesis. Wageningen, The Netherlands: Wageningen Agricultural University.

Brown, K.H., Wuehler, E. and Peerson, J.M. (2001) The importance of zinc in human health and estimation of global prevalence of zinc deficiency. Food Nutr Bull 22: 113S-125S.

Glahn, R.P., Lee, O.A., Yeung, A., Goldman, M.I. and Miller, D.D. (1998) Caco-2 cell ferritin formation predicts nonradolabeled iron availability in an in vitro digestion/Caco-2 cell culture model. J Nutr 128: 1555-61.

Kiers, J. L., Nout, M. J. R. and Rombouts, F. M. (2000) In vitro digestibility of processed and fermented soya bean, cowpea and maize. J Scie Food Agric 80: 1325-1331.

Lestienne, I., Besancon, P., Caporiccio, B., Lullien-Pellerin, V. and Treche, S. (2005) Iron and zinc in vitro availability in pearl millet flours (*Pennisetum glaucum*) with varying phytate, tannin, and fiber contents. J Agric Food Chem 53: 3240-47.