

Evaluation of the *In Vitro* Solubility of Zinc from Sorghum Thick Porridges Prepared by Households in Benin

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INTRODUCTION

Zinc is an essential trace element for human nutrition and it supports important functions in the organism. Zinc deficiencies in the diet lead to much suffering, particularly in developing countries where cereals and vegetables are the main sources of macro- and micronutrients for the population (Svanberg and Lorri 1997, Frossard et al. 2000). The nutrient content and bioavailability in cereals like sorghum are low due to the presence of anti-nutritional factors such as condensed phenolic compounds and phytate.

Sorghum [*Sorghum bicolor* (L.) Moench] is an important staple food in semi-arid regions worldwide (Duodu et al. 2003). The grain is processed into various foods including thin or thick porridges and beverages. In spite of their high frequency of consumption among the sorghum foods, little is known about the micronutrient availability from sorghum porridges.

Basically, the preparation of *dibou* involves cleaning of the sorghum grain, grinding and cooking with variations according to regional traditions. The impact of these process operations on micronutrient levels and their availability in porridge is not known or understood yet.

The present study evaluated the impact of *dibou* process operations on phytate, phenolic compounds and Zn content and solubility.

METHODS

Processing and sampling

Five kg of red sorghum grain, purchased at a local market, were processed into *dibou* by duplicate households following three process scenarios: scenario 1 (dry cleaning - grinding - cooking), scenario 2 (dry cleaning - grinding - sieving - cooking), scenario 3 (wet cleaning - grinding - sieving - cooking). Samples were withdrawn at each process step, dried and ground into flour for analysis.

In vitro digestion and analysis of samples

The in vitro digestion method (Kiers et al. 2000) was used with minor modifications. Zinc, phytate and total phenolic compounds were measured following the methods described by Kayodé et al. (2006). The data were analysed using the statistical program SPSS 11.0. The one-way ANOVA model was used applying the LSD test to evaluate significant difference among means.

RESULTS AND DISCUSSION

Cleaning reduced the phytate content of the grain by 24-39%, while grinding, sieving and cooking had no significant effect on phytate. Phenolic compounds remained constant after cleaning, grinding and sieving, but significantly decreased by 38-65 % after cooking. The Zn solubility was drastically reduced by cooking (Table 1).

Table 1. Changes in total Zn, in vitro soluble ratio Zn, phytate and phenolics content of sorghum grain during *dibou* preparation.

	Total Zn (mg kg ⁻¹ dm) ¹	IVS Ratio Zn (g 100g ⁻¹ dm) ²	Phytate (g 100g ⁻¹ dm)	Total phenolics (g 100g ⁻¹ dm)
Scenario 1 (dry cleaning - grinding - cooking)				
raw	25.4±0.5a	33.3±2.4a	0.80±0.13a	0.22±0.00a
cleaned	25.7±0.7a	30.6±1.9a	0.61±0.12b	0.26±0.01a
ground	24.5±0.3a	29.9±1.3a	0.61±0.12b	0.26±0.01a
cooked	27.0±1.5a	5.6±3.0b	0.70±0.06b	0.16±0.02b
Scenario 2 (dry cleaning - grinding - sieving - cooking)				
raw	25.4±0.5a	33.3±2.4a	0.80±0.13a	0.22±0.00a
cleaned	27.2±1.4a	33.9±1.3a	0.60±0.01b	0.23±0.02a
ground	26.8±1.3a	33.6±1.1a	0.60±0.01b	0.23±0.00a
sieved	25.7±0.8a	33.7±1.0a	0.59±0.04b	0.23±0.02a
cooked	30.5±6.3a	7.3±4.5b	0.62±0.06b	0.08±0.02b
Scenario 3 (wet cleaning - grinding - sieving - cooking)				
raw	25.4±0.5a	33.3±2.4a	0.80±0.13a	0.22±0.00a
cleaned	26.2±1.6a	22.6±3.9b	0.49±0.07b	0.24±0.01a
ground	27.2±0.9a	22.1±2.9b	0.49±0.07b	0.24±0.01a
sieved	26.0±0.9a	22.1±2.1b	0.51±0.09b	0.23±0.02a
cooked	28.1±0.1c	7.0±0.0c	0.51±0.16b	0.15±0.04b

¹ Means ± standard deviation, means with the same letter are not significantly different according to the LSD at the 0.05 level

² In Vitro Soluble Ratio Zn = [{IVS Zn (mg kg⁻¹ dm)} / {Total Zn (mg kg⁻¹ dm)}] x 100.

Levels of total phenolic compounds were highly correlated with Zn solubility with a r^2 of 0.82 indicating the prominent role of phenolics in Zn availability in this type of food.

CONCLUSIONS

The process to make porridges decreases Zn solubility in sorghum. Decortication of sorghum grain prior to processing into porridges is recommended.

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