

## **The effectiveness of cyanogen reduction during cassava processing into miondo**

*Efficacité de la diminution des composés cyanés lors de la  
transformation du manioc en miondo*

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### **- Abstract -**

A study was undertaken to investigate the effectiveness of village processing techniques in reducing cyanogens to very low levels in a Cameroonian cassava based food, miondo.

The sub-processes used in the production of miondo were highly effective in reducing the total cyanogen content of the freshly harvested and unpeeled cassava (396.2-512.0 mg HCN Kg<sup>-1</sup>) to very low levels in the final product (1.4-2.8 mg HCN Kg<sup>-1</sup>) ready for consumption ; this accounted for a mean overall reduction in total cyanogens of 99.5 % (range 99.3-99.6%). On the third day of soaking when the roots had fermented and softened, an appreciable decrease was found in both pH and cyanogen levels which coincided with increases in cyanohydrin contents. In the later stages of processing, most of the residual cyanogens found in the fermented cassava pulp were in the form of cyanohydrins which were partially removed during boiling of the final product. In this study, the most important stages in the production of miondo, with regard to cyanogen reduction, were the soaking, mashing and dewatering sub-processes.

**- Résumé -**

Cette étude a été entreprise pour mesurer l'efficacité des procédés technologiques traditionnels pour réduire suffisamment les teneurs en composés cyanés lors de la préparation d'un produit dérivé du manioc du Cameroun, le miondo.

L'ensemble des procédés utilisés pour la production de miondo s'est révélé très efficace puisqu'il a permis de réduire les teneurs en cyanures totaux dans les racines

## Introduction

Cassava (*Manihot esculenta* Crantz) is a tropical root crop which is a staple food and a major source of calories for over 800 million people in developing

pressed between strongly tied wooden poles, overnight. Following dewatering, the mash was ground in a hammer mill, kneaded into long cylindrical shapes (length 15-20 cm, diameter 1.5-2.0 cm), wrapped in large leaves (*Zingiber officinale*) and bound with raffia. Each bundle of the final product contained 20-single pieces of packaged miondo which was steam boiled for 40 to 55 min. The village processing of cassava roots into miondo is schematically shown by a flow-diagram in Figure 1.

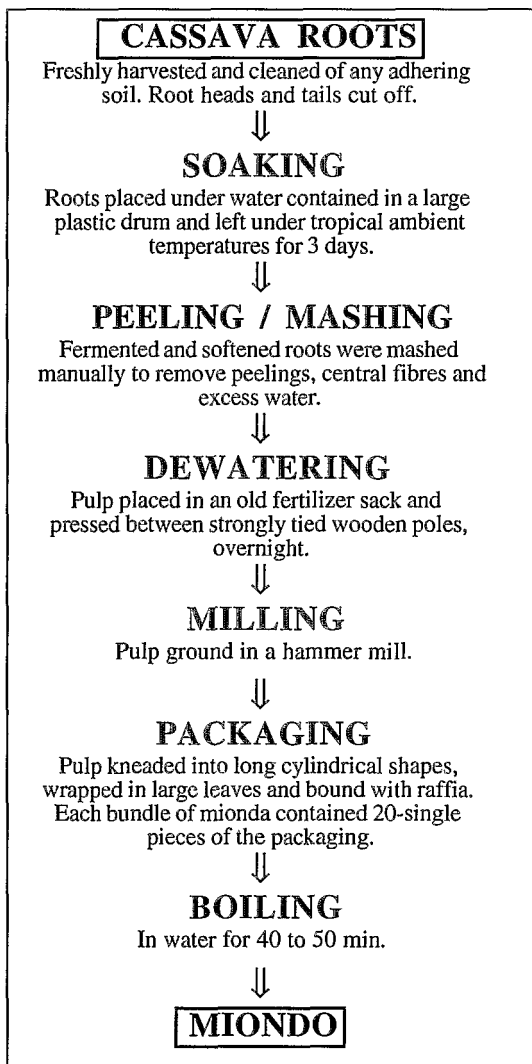


Figure 1  
Processing of Cassava into miondo

## 2. Sampling for chemical analysis

Four market-orientated miondo processors were selected at random for sampling from amongst the households surveyed in a preliminary study on cassava processing. Results obtained in the survey indicated that the processing methods used in the production of miondo did not vary in details from one household to the other and no considerable differences were noticed in other villages found within the studied region.

Samples used this study were obtained from each of the four processors during 4 different miondo preparations. At the beginning of each processing, twenty-five randomly selected cassava roots were collected from each processor. Slices 2 cm-thick were taken from the proximal, centre and distal ends, washed, cut into small cubes, thoroughly mixed together, placed in screw-capped bottles and frozen. At later visits to the village, samples (800 g) were drawn from each sub-process and frozen. When the sampling was over, the frozen samples were stored in an ice-box and transported to the laboratories of the Centre for Food and Nutrition Research, Yaounde in Cameroon for the extraction of cyanogens and subsequent chemical analyses. The temperatures and pHs of the water used in the soaking of the roots were measured daily (1200 and 1600 h), at the surface and bottom of the drums.

## 3. Chemical analysis

Moisture content was estimated by drying fresh and processed samples (5 g) at 105 °C to constant weight while the pH was determined with a combination electrode on a sample (10 g) homogenised with distilled water (20 ml). The extraction and estimation of cyanogens (cyanogenic glucoside, cyanohydrin and hydrogen cyanide) was by the Cooke (1978, 1979) method as modified by O'Brien *et al.* (1991).

# Results and discussion

## 1. Cyanogen levels in freshly harvested cassava

The total cyanogen content of the freshly harvested and unpeeled cassava roots, expressed on a dry weight basis, ranged from 396.2 to 512.0 mg HCN Kg<sup>-1</sup> (Table 1). These ranges are similar to those reported for different cassava varieties (137-884 mg HCN Kg<sup>-1</sup> : Gomez *et al.*, 1984 ; 397.6 mg HCN Kg<sup>-1</sup> : Sokari *et al.*, 1992 ; 91-1515 mg HCN Kg<sup>-1</sup> : O'Brien *et al.*, 1992). The major cyanogen found in the freshly harvested roots was in the form of cyanogenic glucoside, linamarin. However, in spite of the rapid preparation of the roots for chemical analysis, a certain amount of enzymic hydrolysis had occurred which resulted in the small quantities of cyanohydrins and hydrogen cyanide (HCN).

sava processing

-1)	TOTAL		pH
	6-8.2)	434.2 ± 53.7	(396.2-512.0)
0-7.8)	419.6 ± 51.8	(385.6-495.6)	6.64 ± 0.08 (6.55-6.71)
0-7.0)	378.1 ± 45.6	(347.3-445.1)	6.41 ± 0.08 (6.34-6.51)
3-7.9)	202.8 ± 13.7	(186.4-218.3)	5.73 ± 0.05 (5.68-5.79)
2-4.7)	55.9 ± 13.9	(44.4-73.9)	4.35 ± 0.02 (4.32-4.37)
3-2.2)	17.4 ± 7.6	(13.1-28.7)	4.46 ± 0.06 (4.42-4.54)
6-0.9)	6.4 ± 1.7	(4.4-8.2)	4.51 ± 0.03 (4.47-4.55)
3-0.4)	2.3 ± 0.6	(1.4-2.8)	4.59 ± 0.08 (4.49-4.67)

## 2. Effects of processing on cyanogen levels

The sub-processes used in the production of miondo were highly effective in reducing the levels of cyanogens to very low contents (Figure 2). The mean overall reduction in total cyanogens of 99.5 % (range 99.3-99.6%) obtained during the production of miondo corroborate results from other studies that unmodified village processing techniques are capable of effective cassava detoxification (Mahungu *et al.*, 1987 ; Maduagwu, 1979 ; Vasconcelos *et al.*, 1990). Despite the wide range in total cyanogen contents of the freshly harvested roots, it was also observed that during processing similar reduction levels were obtained for the product by all the miondo processors studied (Figure 3). In this study, it was observed that the most important stages, with regard to cyanogen reduction, were the soaking, mashing and dewatering sub-processes. The residual cyanogens in the later stages of processing were in the form of cyanohydrins (Table 1). It has been reported that, in cassava products which have been fermented and processed, most of the residual cyanogen content is likely to be in the form of cyanohydrins and/or HCN (Maduagwu, 1979).

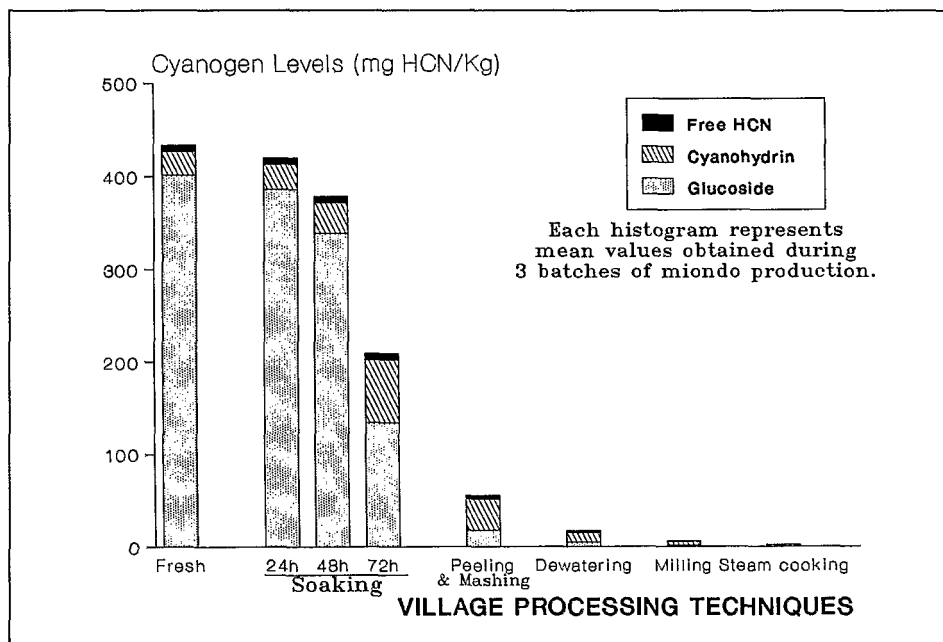
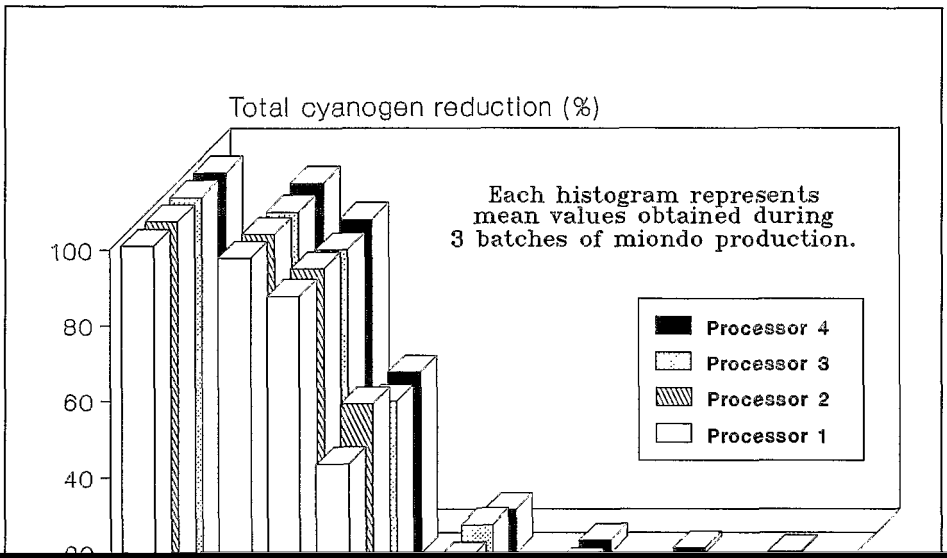


Figure 2

Variations in cyanogen levels during cassava processing into miondo





This hydrolysis occurs spontaneously at pH 4 and above (Fomumyam *et al.*, 1985). The optimum pH of linamarase activity has been shown to be between 5.5 to 6.5 (Cooke, 1978 ; Yeoh, 1989). As shown in Table 2, the temperatures (29-31 °C) and pHs (4.32-6.23) of the soak-waters were conducive in promoting rapid microbial growth and enzyme activity. Results obtained in the Congo have shown that during the production of chikwangue and fufu the reduction of cyanogen levels was fastest when the soak-waters had an optimum temperature of 32 °C (Brauman *et al.*, 1994).

**Table 2**  
*pHs and temperatures of soak-waters during cassava processing*

The rates of roots softening and PH reduction have been shown to be related to the size of the root pieces (Okafor *et al.*, 1984). In this investigation,

PROCESSORS	DAY 0		DAY 1		DAY 2		DAY 3	
	pH	°C	pH	°C	pH	°C	pH	°C
N° 1	6.18	29	5.91	29	5.20	31	4.52	30

volatility (the boiling temperature of HCN is 25.7 °C) of hydrogen cyanide provide easy removal from the fermented cassava pulp during the subsequent processing steps in the production of miondo.

## **Conclusion**

The sub-processes used in the village production of miondo were highly effective in reducing the levels of cyanogens to very low contents. It is evident in this study that, the rates of linamarase activity and the breakdown of cyanohydrins were influenced by the pH of the fermented and softened cassava roots during the different production sub-processes. The various stages used in miondo preparation had the effect of reducing pH and cyanogen levels. Boiling of the final product was necessary in removing some of the residual cyanogen content.

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