# QUALITY ASSESSMENT OF INDUSTRIAL CASSAVA PRODUCTS FROM NIGERIA

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***Abstract:***

*Qualities of industrial cassava flour, gari and starch from Southeast were studied. Southeast is one of the major cassava producing zones in Nigeria. The suitability of the products for export based on moisture content (MC) and hydrogen cyanide (HCN) content was assessed. Purposively three of the five states and seven processing firms in Southeast Zone were sampled. From the lists obtained from relevant agencies, the firms were sampled based on extent of mechanization. Data were collected for three months using questionnaire. Laboratory analysis showed that National Root Crops Research Institute (NRCRI) obtained the best MC (6.0%) and HCN (6.5 mg/kg) for flour, best MC (7.3%) and HCN (8.2 mg/kg) for gari, while Ngor obtained best MC (7.8%) and Nigerian Starch Mill (NSM) best HCN (6.0 mg/kg) for starch. The MC and HCN levels were within export ranges. Using Anova test, significant difference was established in mean MC and HCN levels of all products except for HCN of starch. Poor power supply, bad road network, and processing local cassava varieties constrained products' qualities. The study concludes that the products from Southeast are suitable for export, and that alleviation of identified problems will further improve products' qualities.*

**Key words:** cassava products, traditional products, industrial products, extent of mechanization, assessment, quality, marketing, export, moisture content (MC), hydrogen cyanide (HCN) content, flour, gari and starch

## INTRODUCTION

Cassava (*Manihot esculenta* Crantz) of the euphobiacea family was introduced into Nigeria about the 16$^{th}$ century (Obasi et al., 2003) and has become the world foremost producer (FAO, 2006). Nwajiuba (1995) noted that it is the most important crop in the farming system of Southeast Nigeria. Increases in yield and output led Nigeria to explore industrial processing of cassava into varied and high quality products for industrial use and export. NEPC (2004) listed flour, starch, chips, pellets, ethanol, etc. as cassava industrial export products. Ezedinma et al. (2002) observed that the marketing channels of industrial cassava products are not yet developed but that of traditional products are well developed. Traditionally processed products have low quality and are not standardized. Cassava starch, one of the cassava industrial and export products had not met the required qualities. Pharmaceutical and textile industries reject Nigerian cassava starch because of high moisture content (MC) and high hydrogen cyanide (HCN) content (Ugwu, 2000; FAO, 2006). Sanni et al. (2005) stressed the need for products standardization to facilitate local industrial use and export. Presidential initiative on cassava was launched to promote production of varied and high quality cassava products for use in local industries and for export.

African countries including Nigeria lost about US $372 604 714 worth of food and produce to US market between 1990–1992 due to poor product qualities (Sasore, 2005). Many authors have cited export MC and HCN standards for cassava products in the export market. Sanni et al. (2005) recommended the following exports standards, MC of 10% and HCN of 10 mg/kg, 7% MC and HCN of 20 mg/kg, and 12% MC and HCN of 10 mg/kg for flour, gari and starch respectively. Odii and Obih (2000) recommended 6–10% MC for gari. Government has set up some agencies to assist firms realize the varied and exportable cassava products objectives. The Standards Organization of Nigeria (SON) was set up to formulate standards for Nigeria products, the National Agency for Food and Drug Administration and Control (NAFDAC) was set up to inspect and approve such products for sale and consumption, while the Nigerian Export Promotion Council (NEPC) was established to assist investors to package and export their products (Sanni et al., 2005). To ascertain the MC and HCN quality conditions of the selected cassava products in Southeast Zone necessitated this study.

Nigeria wants to maximize profit from its increased cassava output. Profit maximization is based on large-scale production of high quality products. Poor quality products do not attract buyers rather they cause glut in products sales, but high quality products attract buyers even at premium price at local and export markets (Sasore, 2005). Since cassava is the most important crop in the farming system of Southeast Zone of Nigeria, improvements in cassava products marketing will benefit many farming households. Export marketing of cassava products will diversify foreign exchange earning of the country. Literature has not shown much on quality attainments of cassava products in the Zone. This study was undertaken to provide such information on the selected cassava products of the sampled firms. The specific objectives were to analyse the MC and HCN levels of flour, gari and starch of the sampled firms, compare the attained levels with export standards and establish their potentials for export, establish significant difference in the mean MC and HCN of the products, identify the problems facing the firms and make recommendations to alleviate the problems.

## MATERIALS AND METHODS

The study was conducted in Southeast Geo-Political Zone of Nigeria because it is among the three largest producers of cassava in the country, and the Southeast Economic Summit wants to explore the cassava aspect of the Presidential Initiative on Agriculture in Nigeria. Southeast is in the tropical rain forest zone of Nigeria (Dada et al., 2007). Three industrial cassava products, flour, gari and starch were purposively selected because flour and starch are listed among the varied and export cassava products (NEPC, 2004), while gari, a traditional cassava food product has pushed the cassava industry from traditional to semi-mechanized processing among farming households (FAO, 2006). Its export will enhance the income of these households. Moisture and hydrogen cyanide contents were assessed because they are important export quality parameters of agricultural products (Sanni et al., 2005). Abia, Anambra and Imo States were purposively sampled among the five states in the Zone because each has large mechanized cassava processing firm. From lists obtained from Nigerian Export Promotion Council, Raw Materials Research and Development Council and Agricultural Development Programs in the Zone, seven firms producing flour, gari and or starch were purposively sampled based on their rates of mechanization. The firms were Integrated Cassava Processing Project, National Root Crops Research Institute Umudike (NRCRI), Aquada Development Corporation, Ubakala Umuahia (Aquada), Kaka Confectionaries Mission Hill Umuahia (Kaka), Nigerian Starch Mill Ihiala (NSM), Ultra Modern Cassava Processing Plant, Michael Okpara College of Agriculture (now Imo State Polytechnic) Umuagwo (MOCA), Steve-Noras Group, Ogii Okigwe (Steve) and Ezienyi Farmers' Multipurpose Co-operatives, Umuneke Ngor (Ngor). Products were collected for February, June and November, 2007 and respectively sent for analysis at the Biochemistry Laboratory of NRCRI Umudike. The months were to reflect the soil moisture contents which may affect the chemical composition of roots. Three sets of questionnaire were used to collect data, one for flour processors, one for gari processors and the other for starch processors. The mean MC and HCN contents of the products were calculated from the results of the laboratory analysis. One-way analysis of variance was used to test the hypothesis of no significant difference in the mean MC and HCN contents of the sampled flour, gari and starch.

Ho: $X_1 = X_2 = X_3 = X_4 = X_5$,

where $X_1$–$X_5$ = mean MC (or HCN) of the products.

Least significant difference (LSD) was used to separate identified mean differences at 0.05 probability. The attained mean MC and HCN were compared with the recommended export standards to ascertain their suitability for export.

## RESULTS AND DISCUSSION

**1. Attained flour qualities and export standards:** Table 1 shows the mean moisture content (MC) and mean hydrogen cyanide (HCN) content results of laboratory analysis of flour from the five sampled firms. NRCRI obtained the least MC of 6.0% while Aquada obtained the highest, 7.5%. While Kaka, MOCA and Steve obtained the least HCN of 6.0 mg/kg, Aquada obtained the highest, 6.7 mg/kg. The attained MC and HCN levels were less and better than the standards of 10% MC and 10 mg per kg HCN recommended by Sanni et al. (2005). This makes flour from each of the firms suitable for export.

**2. Attained gari quality and export standards:** Table 2 shows the mean results of laboratory analysis of MC and HCN levels of gari from the five sampled firms. It shows that NRCRI produced gari with the least MC, 7.3% and Ngor produced that with the highest MC 9.2%. NRCRI's gari contained the least HCN of 8.2 mg/kg while MOCA and Ngor produced gari with the highest HCN, 9.0 mg per kg. The attained MC range, 7.3–9.5% falls within the export MC range of 6–10%; while the HCN range of 8.2–9.0 mg/kg was less than the recommended HCN of

**Tab. 1:** Mean flour MC and HCN levels attained by sampled firms

| Quality variables | Firms and quality levels attained | | | | |
|---|---|---|---|---|---|
| | Aquada | Kaka | MOCA | Steve | NRCRI |
| MC (%) | 7.5 | 6.2 | 6.2 | 72 | 6.0 |
| HCN (mg/kg) | 6.7 | 6.0 | 6.0 | 6.0 | 6.5 |

Source: Laboratory results of field data (2007)

**Tab. 2:** Mean gari MC and HCN levels attained by sampled firms

| Quality variables | Firms and quality levels attained | | | | |
|---|---|---|---|---|---|
| | MOCA | Ngor | Kaka | Steve | NRCRI |
| MC (%) | 8.2 | 9.2 | 8.5 | 8.3 | 7.3 |
| HCN (mg/kg) | 9.0 | 9.0 | 8.7 | 8.5 | 8.2 |

Source: Laboratory results of field data (2007)

20 mg/kg. Sanni et al. (2005) recommended maximum of 7.0% MC or less as the required MC for exportable gari; Odii and Obih (2000) recommended 6–10%. Sanni et al. (2005) also recommended 20.0 mg/kg HCN as the acceptable level for gari export. The attained MC and HCN levels fall within the recommended ranges for export. The products are therefore suitable for export.

**3. Attained starch quality and export standards:** Table 3 shows the mean starch MC and HCN levels obtained from laboratory analysis. It shows that starch from NSM has the highest MC, 11%; Ngor has the least, 7.8% and Steve has 8.0%. However NSM obtained starch with the least HCN of 6.0 mg/kg, Steve obtained the highest of 7.2 mg/kg; while Ngor had 6.5 mg/kg. The MC levels were below the 12% recommended by Sanni et al. (2005). The attained HCN levels were below 10 mg/kg also recommended by Sanni et al. (2005). The attained MC and HCN levels were better than the recommended levels making the products suitable for export.

**Tab. 3:** Mean starch MC and HCN levels attained by sampled firms

| Quality variables | Firms and quality levels attained | | |
|---|---|---|---|
| | NSM | Ngor | Steve |
| MC (%) | 11 | 7.8 | 8.0 |
| HCN (mg/kg) | 6.0 | 6.5 | 7.2 |

Source: Laboratory results of field data (2007)

**4. Comparison of attained mean MC of products of sampled firms:** Table 4 shows the products, the firms producing them, the attained levels of mean MC and Anova ranks of mean differences. It also shows that four firms Kaka, MOCA, Steve and NRCRI produced both flour and gari. Steve in addition produced starch, while Ngor produced gari and starch. Aquada and NSM produced only flour and starch respectively.

Analysis of no significant difference in mean MC of flour was conducted.

Table 4 shows the mean MC of flour from the five sampled firms. It also shows their Anova ranks. The ranks indicate statistical difference in their means. Only Kaka and MOCA had the same rank, 'c' with the MC of 6.2% each. Their MC were therefore not statistically different from each other but differs statistically from the means of the other three firms. Aquada had the highest MC

**Tab. 4:** Attained mean MC and ANOVA ranks of mean differences of products of sampled firms.

| Products | Firms, attained mean MC (%) and ANOVA Ranks | | | | | | |
|---|---|---|---|---|---|---|---|
| | Aquada | Kaka | MOCA | Steve | NRCRI | NSM | Ngor |
| Flour | $7.5^{a}$ | $6.2^{c}$ | $6.2^{c}$ | $7.2^{b}$ | $6.0^{d}$ | * | * |
| Gari | * | $8.5^{b}$ | $8.2^{c}$ | $8.3^{c}$ | $7.3^{d}$ | * | $9.5^{a}$ |
| Starch | * | * | * | $8.0^{b}$ | * | $11^{a}$ | $7.8^{b}$ |

a, b, c, d = ANOVA ranks of mean differences; * = products not produced by firms
Means having the same letter rank are not significantly different at 0.05 probability according to LSD

Source: Laboratory results of field data (2007)

(7.5%) with rank ‘a’. while NRCRI had the least (6.0%) with rank ‘d’. Steve had MC of 7.2% and was ranked ‘b’. The null hypothesis of no significant difference in their mean MC was rejected and the alternative was accepted.

Analysis of no significant difference in mean MC of gari was also conducted. Table 4 shows the mean MC of gari from the five sampled firms with their Anova ranks. The ranks show no statistical difference in the means of MOCA and Steve products, both were ranked ‘c’ with mean MC of 8.2% and 8.3% respectively. Gari from Ngor had the highest MC of 9.5% and was ranked ‘a’, NRCRI had the least (7.3%) and was ranked ‘d’. Kaka product with mean of 8.5% was ranked ‘b’. The null hypothesis of no significant difference in mean MC of gari was therefore rejected.

Analysis of no significant difference in mean was also conducted for MC of starch. Significant difference was identified in their mean MC, and the null hypothesis was rejected. Table 4 shows the mean MC of starch from three sampled firms and their Anova ranks. The mean starch MC of Steve (8.0%) and Ngor (7.8%) were both ranked ‘b’, while that of NSM (11%) was ranked ‘a’. The different ranks indicate significant difference in mean; hence the null hypothesis was rejected.

**5. Comparison of attained mean HCN of products of sampled firms:** Table 5 shows the products and the firms producing them, the attained mean HCN and Anova ranks of mean differences.

Analysis of no significant difference in the mean HCN of flour was conducted. Table 5 shows that there is no significant difference in the mean HCN of Kaka, MOCA and Steve flour. Each had a mean HCN of 6.0 mg/kg and were respectively ranked ‘c’. Their means differ significantly from those of Aquada and NRCRI. While Aquada had HCN of 6.7 mg/kg, NRCRI had 6.5 mg/kg. Both were ranked ‘a’ and ‘b’ respectively. The null hypothesis of no significant difference in their mean HCN was rejected.

Analysis of no significant difference in the mean HCN of gari was conducted. Significant difference in the mean HCN of products of the five sampled firms was established. Table 5 shows that gari from MOCA and Ngor had the highest HCN of 9.0 mg/kg and were ranked ‘a’, showing that no significant difference existed between their means. Kaka, Steve and NRCRI gari respectively had 8.7 mg/kg, 8.5 mg/kg and 8.2 mg/kg and were respectively ranked ‘b’, ‘c’ and ‘d’. This indicates significant difference in their means and the means of MOCA and Ngor. The null hypothesis of no significant difference in their mean HCN was therefore rejected.

Analysis of no significant difference in the mean HCN of starch was conducted. The mean HCN content for starch from the three sampled firms were 7.2 mg/kg, 6.0 mg/kg and 6.5 mg/kg for Steve, NSM and Ngor respectively. Each was ranked ‘a’ showing that there was no significant difference in their means. The null hypothesis of no significant difference in the means of starch was therefore accepted.

**6. Constraints to production of high quality cassava products**: Though the attained MC and HCN levels of the selected products of the sampled firms were within the ranges of export standards, some firms’ MC and HCN levels were higher than others. Anova rank shows that flour MC of Aquada (7.5%) was statistically the highest when compared to those of other flour firms. Ngor had the highest MC (9.5%) among gari firms while NSM had the highest (11%) among starch firms (Table 4). Aquada and Ngor attributed the high MC of their products to the inexperience of staff in using the drying machines. However, NSM indicated satisfaction with the MC of its products because its customers do not complain.

Anova rank shows that the HCN of Aquada flour (6.7 mg/kg) was statistically higher than those of other firms; while that of MOCA and Ngor, both 9.0 mg/kg, were significantly higher than those of other gari firms. No significant difference was identified in the mean HCN of starch (Table 5). Aquada and Ngor attributed the high HCN of their products to the processing of local cassava varieties which have higher cyanide content than the improved varieties of the International Institute of Tropical Agriculture (IITA) processed by other firms. Poor power supply and bad road network were other constraints to

**Tab. 5:** Attained mean HCN and ANOVA ranks of mean differences of products of sampled firms

| Products | Attained mean HCN (mg/kg) and ANOVA Ranks | | | | | | |
|---|---|---|---|---|---|---|---|
| | Aquada | Kaka | MOCA | Steve | NRCRI | NSM | Ngor |
| Flour | 6.7[a] | 6.0[c] | 6.0[c] | 6.0[c] | 6.5[b] | * | * |
| Gari | * | 8.7[b] | 9.0[a] | 8.5[c] | 8.2[d] | * | 9.0[a] |
| Starch | * | * | * | 7.2[a] | * | 6.0[a] | 6.5[a] |

a, b, c, d = ANOVA ranks of mean differences; * = products not produced by firms
Means having the same rank are not significantly different at 0.05 probability according to LSD

Source: Laboratory results of field data (2007) cassava products qualities. They delay timely processing of roots, and delayed processing leads to root deterioration and poor products' qualities.

## CONCLUSION

The study concludes that based on the mean MC and HCN results of laboratory analysis, the sampled cassava products are suitable for local industrial use and export market. It attributes high MC of products of some firms to inexperience in the use of installed drying machines, and high HCN to processing of local cassava varieties. The low products qualities of some firms' products are also attributed to inadequate power supply and poor road network as both inadequacies delay processing of roots.

The study advices firms whose products have high MC to train their staff properly in the use of drying machines, while those with products of high HCN should process more of the IITA's improved cassava varieties. It also concludes that provision of adequate power supply and good road network will further improve quality of cassava products, and attract higher profit at local and export markets.

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