

Material Losses and Garri Recovery Rate during the Processing of Varieties of Cassava into Garri

E.A. Udom¹, P.C. Eze², C. N. Eze³

¹Abak Irrigation Project, Cross River Basin Development Authority, Calabar, Nigeria.

^{2,3}Department of Agricultural and Bioresource Engineering, Enugu State University of Science and Technology, Enugu, Nigeria.

Abstract— *Materials losses and garri yield during garri processing on different cassava varieties; TMS/92/0057, TMS/30572, TME/419 and Vitamin A: 01/1368 were conducted. The results showed that there were variations within the different processing unit as well as the cassava varieties during garri processing. Losses were recorded highest at grating, dewatering and fermentation processes with the values of 9kg from TMS/92/0057 recording the highest loss, 8.5kg from Vitamin A: 01/1368, 7.7kg from TMS/30572 and 7kg from TME/419. On roasting processes, TMS/30572 had 3.2kg loss, Vitamin A: 01/1368, had 2.5kg loss, while TME/419 and TMS/92/0057 had 2kg loss respectively. Material losses at peeling showed that Vitamin A: 01/1368 recorded 4.5kg loss being the highest, TMS/92/0057 and TME/419 recorded 3kg loss each, while TMS/30572 recorded 2.5kg loss. Sifting losses indicated that vitamin A: 01/1368 and TME/419 had 1kg loss each, whereas TMS/30572 had 0.8kg loss and TMS/92/0057 had 0.5kg loss. Overall material loss for each cassava variety based on fresh weight of 20kg and maturity age of 14 weeks was determined, which vitamin A: 01/1368 recorded the highest loss of 16.5kg, TMS/92/0057 had 14.5kg loss, TMS/30572 had 14.2kg loss and TME/419 recorded 13kg loss. The total garri yield from each variety was also determined with TME/419 having 7kg yield, TMS/30572 had 5.8kg yield, TMS/92/0057 had 5.5kg yield and Vitamin A: 01/1368 recorded 3.5kg yield. Percentage losses from the tested varieties showed that vitamin A: 01/1368 had the highest percentage of 82.5% loss, TMS/92/0057 had 72.5% loss, TMS/30572 had 71% loss and TME/419 recorded 65% loss. Percentage yield of garri was also determined on the cassava varieties, this showed that TME/419 had 35% yield being the maximum, TMS/30572 had 29% yield, TMS/92/0057 had 27.5% yield and Vitamin A: 01/1368 recorded 17.5% yield.*

Keywords— *Garri processing, Garri loss, grating, roasting, yield.*

I. INTRODUCTION

Cassava (*Manihot Esculenta Crantz*) is a staple food in most tropical regions, and is grown over a range of

climate and altitudes and on a wide variety of soils (Tivana 2012). Cassava is one of the most important crops in Nigeria and Africa as a whole (Amadi et al 2011, Nweke et al 2002). Cassava is tolerant to drought; it is productive in poor soil where other staple crops cannot grow without intensive inputs (Tivana 2012, Bradbury and Holloway 1988, and Leihner 2002). Cassava has special attributes which include ability to make return of root yield even at extreme stress conditions, high tolerance to unfavorable conditions, all year round availability, highly suitable to various farming and food system in Africa as well as efficient production of food energy. (Amadi et al 2011, Beeching et al 2000, Awa and Tumanteh, 2001). However, cassava has certain drawbacks, its tissues contain toxic cyanogenic compounds, it has a very low protein content (1-2% dw) and a very short shelf life in fresh form of 1-3 days (Booth et al 1974, Rickard, 1985, Westby, 2002). The roots and leaves which contain various amounts of cyanide at high levels are toxic to both humans and animals. Therefore after harvest cassava has to be quickly converted into suitable forms of low cyanide with longer and stable shelf life (Asiedu 1989, Opara 1999). The processing of cassava into various forms that combine the advantages of diversity, nutritional value and convenience of use is further means of promoting its consumption among different strata of the society (Oduro and Ellis, 2000). The various derivatives into which fresh cassava roots can be processed are unlimited. By far its processing into a fermented dried, granular food product called garri is more popular in Nigeria and as well as in sub-saharan Africa than other derivatives (Asiedu 1989, Opara 1999). Improved processing techniques which significantly reduced drudgeries and difficulties associated with traditional methods transformed garri as one of the fore most Nigeria staple. More about garri is that it is convenient, ready to eat, storable and easily processed to conform to the organoleptic preferences of the consumers (Sani et al 1994). Garri processing is becoming a fast expanding enterprise, providing employment and income generation opportunities for farmers and commercially oriented individuals in the rural economy. Over the years

and by indigenous practices, processing of cassava roots into such major products like fufu, abacha (african salad), starch, and garri were based on local preferences and feeding patterns. Fufu otherwise called wet paste was the most popular cassava products in Nigeria especial in the eastern and south south zones as it was mostly preferred and consumed by many farm house holds due to its perceived attributes of providing instant vigor for physical labor as well as thickening a man's bones (Amadi et al 2011). But on the other hand, lacked of storage quality for use in famine period, cannot be consumed instantly commands low market demand and still not easily portable. Garri soon became popular choice of consumers owing to its long storability and ready to eat attributes. Therefore, the purpose of this study was to compare garri yielding amount among cassava varieties, material loss within each processing limit and determined the amount of garri that can be produced from any quantifying amount of raw cassava tubers maturity based on varieties; TMS 9210057, TMS 30572, TME 419 and vitamin A: 011368.

II. MATERIAL AND METHODS

CASSAVA TUBER OR CASSAVA ROOTS:

The cassava tubers or roots used in the research work were harvested from the Cross River Basin Development Authority farm, at the maturity age of 14 months. The varieties were of improved type commonly planted by the farmers within the farm, Akwa Ibom and Cross River State. The varieties include TMS/92/0057, TMS/30572, TME/419 and Vitamin A: 01/1368.

EQUIPMENT

The following equipment were used to estimate the material losses and the garri yield from the various cassava varieties. These include; enamel basin, sack (bags), fire wood, water, palm oil, calabash (for tossing the particles during frying), Jute sack (for storing or marketing), peeling knives, cassava grater (powered by 5hp diesel engine), a double screw press, a rectangle wooden box sifter, an insulated – walled chimney stove with an open iron pan on the fire box and weighing balance, this was used to obtain the weight of the processed roots from each unit operation. It has an accuracy of + 0.05kg.

III. EXPERIMENTAL DESIGN AND PROCEDURES

The research study centre is located at Abak Irrigation Project of the Cross River Basin Development Authority Calabar, Nigeria, which lies within latitude 4°58' and

longitude 7°48' with an elevation of 30 meter above sea level. The material losses from each cassava variety were based on the following processing units and the equation that followed based on measured weight after each operation.

Peeling Losses (LP)

If w_f is the initial weight of fresh cassava tubers in kilogram, and w_p is the weight of peeled tubers. Then $w_f - w_p$ represents the peeling losses.

$$\text{Peeling losses (LP)} = w_f - w_p \quad \text{--- (i)}$$

Grating/Dewatering/Fermentation Losses (LGD)

Let w_{gd} is weight of dough after grating/fermentation and dewatering.

$$\text{Then grating/dewatering/fermentation losses (LGD)} = w_p - w_{gd} \quad \text{--- (ii)}$$

Sifting Losses (LS)

Material losses during sifting are mainly due to spillage, the residual fiber and un-grated masses that are retained over the sifter. If w_s is the weight after sifting, then $w_{gd} - w_s$ represents the sifting loss (LS)

$$\text{Sifting losses (LS)} = w_{gd} - w_s \quad \text{--- (iii)}$$

Roasting Losses (RL)

Material losses encountered at the roasting stage include evaporation of moisture into the atmosphere as well as spillage of particles as the operator stirs through with a portion of calabash. Let w_r be the weight of roasted flour (garri) then $w_s - w_r$ represents the roasting losses. Therefore;

$$\text{Roasting losses (RL)} = w_s - w_r \quad \text{--- (iv)}$$

Similarly the percentage losses for each processing unit on each cassava variety can be obtained from the following equations

$$\text{Percentage Peeling Loss (LPP)} = \frac{w_f - w_p}{w_f} \times \frac{100}{1} \quad \text{--- (v)}$$

Where; LPP = percentage peeling loss (%), w_f = fresh cassava root weight (kg), w_p = weight after peeled or weight of peeled tubers (kg).

$$\text{Equally equation (v) can be written as; } LPP = \frac{LP}{w_f} \times \frac{100}{1} \quad \text{--- (vi)}$$

Where; LPP = percentage peeling losses (%), w_f = fresh cassava root weight (kg)

$$\text{Percentage grating/dewatering/fermentation losses (LGDP)} = \frac{Lgd}{w_f} \times \frac{100}{1} \quad \text{--- (vii)}$$

Where; Lgdp = percentage grating/dewatering/fermentation losses (%),

Ldg = grating/dewatering/fermentation losses, w_f = fresh cassava root weight (kg)

$$\text{Percentage Sifting Losses (LSP)} = \frac{Ls}{w_f} \times \frac{100}{1} \quad \text{--- (viii)}$$

Where; LSP = percentage sifting losses (%), ls = sifting losses, wf = fresh cassava root weight (kg).

$$\text{Percentage Roasting Losses } (R_{LP}) = \frac{R_L}{wf} \times \frac{100}{1} \quad (\text{ix})$$

Where R_{LP} = percentage roasting losses (%), R_L = roasting losses, wf = fresh cassava root weight (kg).

IV. DETERMINATION OF MATERIAL LOSSES

The total loss for each cassava variety was obtained by adding all the losses in equation i to iv as applicable to each variety.

GARRI YIELD DETERMINATION

To obtain the yield of garri from each cassava variety, the fresh weight of each variety minus the material loss from each variety gives the garri yield.

PERCENTAGE LOSSES DETERMINATION

The percentage losses for each cassava variety was obtained by adding all the processing unit losses of each variety together and divide by the fresh weight times 100.

PERCENTAGE YIELD OF GARRI DETERMINATION

The percentage yield of garri from each cassava variety obtained by subtracting losses percentage of each variety from 100.

V. RESULT AND DISCUSSION

The material losses in (kg) for different unit operations on each cassava variety at the same age of maturity is shown in Table 1 below. The TMS/92/0057 variety has the following material losses in each unit processing; peeling recorded 3kg, grating/dewatering/fermentation was 9kg, sifting was 0.5kg and roasting recorded 2kg (table1), while TMS/30572 recorded 2.5kg on peeling, 7.7kg on grating/dewatering/fermentation, 0.8kg on sifting and 3.2kg on roasting (table1). TME/419 variety recorded 3.0kg on peeling, grating/dewatering/fermentation was 7kg, sifting was 1kg and roasting 2kg, while Vitamin A01/1368 on peeling had 4.5kg, grating dewatering/fermentation 8.5kg, sifting 1kg and roasting 2.5kg.

Table.1: Material Losses in kg for the different unit operations for TMS/92/0057, TMS/30572, TME/419 and Vitamin A: 01/1368.

Cassava Variety	Age at Harvest (kg)	Fresh Weight of Root (kg)	Peeling Losses (kg)	Grating/ Dewatering/ Fermentation (kg)	Sifting Losses (kg)	Roasting Losses (kg)	Total Losses (kg)	Yield of Garri in (kg)
TMS/92/0057	14	20	3.0	9	0.5	2	14.5	5.5
TMS/30572	14	20	2.5	7.7	0.8	3.2	14.2	5.8
TME/419	14	20	3.0	7	1	2	13	7
Vitamin A:01/1368	14	20	4.5	8.5	1	2.5	16.5	3.5

Percentage materials losses for the different unit operations for different cassava varieties were also obtained (Table 2) for TMS/92/0057, the peeling loss percentage was 15%, grating/dewatering/fermentation had on record 45%, sifting was 2.5% , 10% on roasting and total loss percentage for TMS/92/0057 was 72.5%. TMS/30572 with peeling loss percent was 12.5%, grating/dewatering/fermentation 38.5%, sifting 4.0%,

roasting 16.0% and a total of 71% losses was obtained. TME/419 had on peeling 15%, grating/dewatering/fermentation 35%, sifting 5%, roasting 10% and had a total of 65% losses (table 2). Vitamin A: 01/1368 had on its processing units as follows; peeling 22.5%, grating/sifting/dewatering 42.5%, sifting 5%, roasting 12.5%, and with total percentage losses of 82.5% (table 2).

Table.2: Percentage Material Losses for the different unit operations for different cassava varieties TMS/92/0057, TMS/30572, TME/419 and Vitamin A: 01/1368.

Cassava Variety	Age at Harvest (months) (%)	Peeling Losses (%)	Grating/ Dewatering/ Fermentation Losses (%)	Sifting Losses (%)	Roasting Losses (%)	Total Losses (%)
TMS92/0057	14	15	45	2.5	10	72.5
TMS30572	14	12.5	38.5	4.0	16.0	71
TME419	14	15	35	5	10	65
Vitamin A:01/1368	14	22.5	42.5	5	12.5	82.5

PERCENTAGE YIELD OF GARRI

The percentage garri yield was also obtained. TMS/92/0057 had a yield percentage of 27.5%. While TMS/30572 had 29%, TME/419 had 35% and Vitamin A:01/1368, 17.5%, see table 3.

Table.3: Percentage Yield of Garri from the different Cassava Varieties

Cassava varieties	Percentage yield
TMS/92/0057	27.5
TMS/30572	29
TME/419	35
Vitamin A:01/1368	17.5

The material losses in kg at different stages of processing and the final garri yield from the different cassava varieties harvested at the same age (14 months) of maturity are shown in table 1. Peeling loss was highest on vitamin A: 01/1368 with 4.5kg. While TMS/92/0057 and TME/419 has 3kg losses respectively and TMS/30572 with a loss of 2.5kg. From records on grating/dewatering/fermentation; Vitamin A: 01/1368 had a loss of 8.5kg, TMS/92/0057 had 9kg, TMS/30572 had 7.7kg and TME/419 had 7kg. This indicates that Vitamin A:01/1368 had the greater loss on grating/dewatering/fermentation. 1kg was obtained from sifting for both vitamin A:01/1368 and TME/419.

TMS/30572 got 0.8 and TMS/92/0057 had 0.5. Roasting losses had the highest losses of 3.2kg on TMS/30572 and followed by Vitamin A:01/1368 of point 2.5kg losses while TME/419 and TMS/92/0057 had 2kg respectively. The highest total loss was recorded on vitamin A: 01/1368 of 16.5kg from initial weight of the fresh tubers see table 4.1 while the highest garri yield was recorded from TME/419 of 7kg (table 1). The percentage material losses for the different unit operations were also obtained. From each cassava variety. Peeling percentage loss evaluated, the results showed that Vitamin A: 01/1368 had the highest value of 22.5%, following by TME/419 and TMS/92/0057 of 15% respectively and TMS/30572 with 12.5%. Grating/dewatering/fermentation recorded 45% from TMS/92/0057, followed by 42.5% from Vitamin A: 01/1368. 38.5% and 35% were obtained from TMS/30572 and TME/419 respectively. Sifting losses records showed that Vitamin A: 01/1368 and TME/419 had the same value of 5% respectively, while TMS/30572 had 4.0% and TMS/92/0057 2.5%. Roasting percentage losses showed 16.0% from TMS/30572, 12.5% on Vitamin A:01/1368 and 10% each from TME/419 and TMS/92/0057. The total percentage losses were recorded as follows, Vitamin A:01/1368; 82.5%, TMS/92/0057; 72.5%, TMS/30572; 71% and TME419; 65% having the least value. See table 2. Also the percentage losses of the four cassava varieties is shown in Fig. 1.

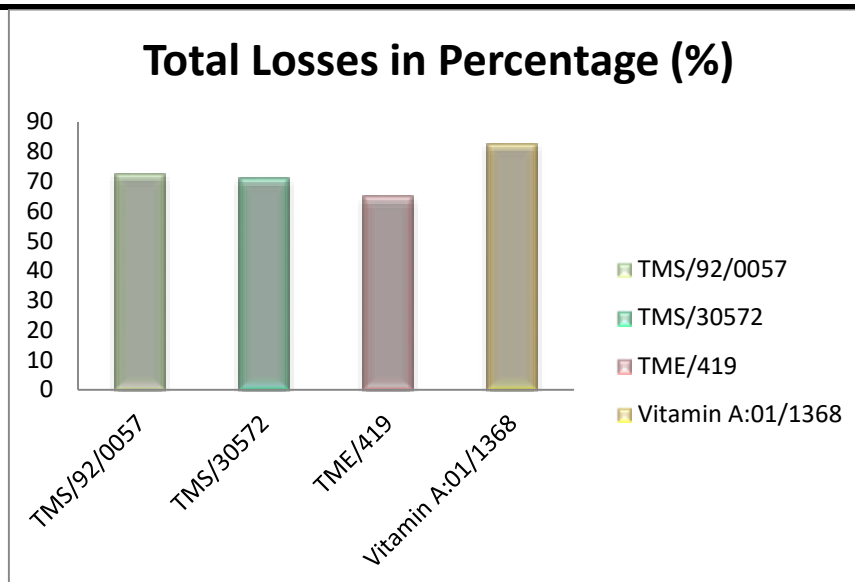


Fig.1: Total losses of four cassava varieties in percentage during garri processing.

Percentage yield of garri was determined based on the initial fresh tuber weight of the different cassava varieties (table 3). The highest value of garri yield was obtained from TME/419 of 35%, TME/30572 recorded 29% yield

and Vitamin A: 01/1368 had the least value of 17.5% (table 3). Fig 2 also shows the percentage yield of garri from the four cassava varieties.

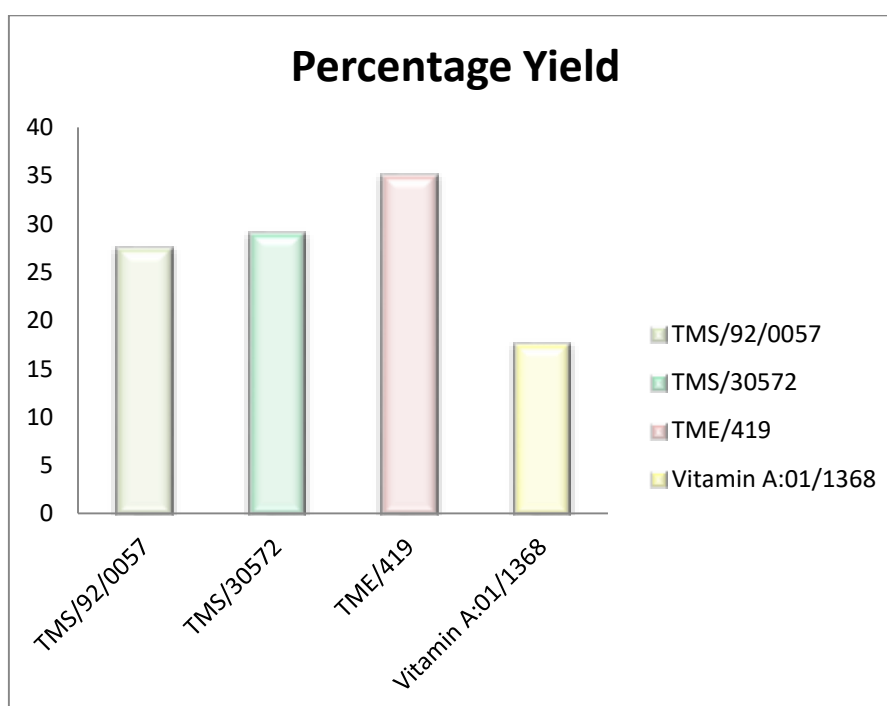


Fig. 2: Percentage yield of four cassava varieties during garri processing.

VI. CONCLUSION

It has been established from this study that different cassava varieties have their different varietal characteristics and that these account for material losses which consequently affect the garri yield from any given set of processing equipment and method.

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