CHARACTERISATION OF GARI FRYING STATIONS IN IFO LOCAL GOVERNMENT, OGUN STATE, NIGERIA

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Abstract

Ifo Local Government area and it’s environ in Ogun state which is located in the south-western part of Nigeria includes Ifo town and Ibogun villages. A survey was carried out on forty different gari-frying stations and processors within this area identifying their characteristics. These characteristics are those that have to do with the workstation, gari-frying utensils and the worker (processor). This was done using Probability Tree Analysis. Also, a correlation coefficient between the worker’s arm length and the mean distance of the pan was calculated. It was discovered that 97.5% of the workstations were local and were located outdoor using a pan of an average size of 63.4cm; 25% of the population took the frontal sitting posture; 87.5% of the workers interviewed were female and 57.14% of these female workers were above 40 years of age. The result also showed that a typical gari frying station in Ifo Local Government area will be located outdoor with a locally made frying chamber and a circular frying pan whose average diameter will be 64.3cm. A female worker above youthful age with an arm length of 67.7cm and working experience of more than 16 years will be sitting sideways while frying gari. There was a negative correlation between the pan mean distance and the worker’s arm length. This result further reveals the dominance of the local method of frying gari in Ifo Local Government area and the dominance of women in gari frying.

Keywords: Gari-frying, cassava, probability tree, workstation, worker.

Introduction

Gari is a free-flowing product, consisting of cassava particles, which have been gelatinized and dried. The size of these particles varies from one locality to another according to consumer preferences. Gari is creamy white or yellow, depending on the type of cassava used or whether palm oil has been added. Gari, one of the traditional products of cassava processing, is commonly consumed by the rich and the poor, the elite and the uneducated, and is now being exported to other parts of the world (R.M.R.D.C, 2004).

Oloko et al (2006) investigated the status of gari processing in Ondo state. They were able to draw out a representative flow chart for the production of gari in Ondo state as shown in Figure 1:
Adeyemo et al (2006) also came up with a similar flow chart when they examined the exiting cassava processing technologies in Southern Nigeria, covering Ogun, Edo and Anambra states. Methods used in the production of *gari* vary from one location to another, but there are similarities, having just little differences.

*Gari* frying or *garification* is the most critical unit operation in the processing of cassava into *gari*. The quality of the final product is much dependent on *garification* which is a combination of simultaneous cooking and drying processes (Igbeka, 1995).

Igbeka (1995) divided the traditional *gari*-frying method into the following steps:

- Earthen-ware of cast-iron pans is placed over firewood.
- Spatula-like paddle of wood or calabash section is used to press the sieved mash against the hot surface of the frying pan.
- Content is turned vigorously to avoid caking.
- Operator sits sideways by the fireplace to observe the frying process.

**Classification of Gari-Frying Stations**

1. Method
   i. Local: this is a traditional method usually found in rural areas. These *gari* fryers are in their crudest form. It is usually located under a shed having a heat chamber made of earth materials with a pan (usually circular) placed on them for frying. They do not have any specially designed seat as any available seat is used.
   ii. Improved: this method is just an improvement on the local method. It does not differ in the process and task operations involved. Some ergonomic improvements have been made to the crude (local) method. Some of these designs as stated by Igbeka (1995) are as follows:
      a. UNIBADAN improved fryer
      b. IITA model
      c. RAIDS model
   Some other ones where identified by Samuel et al (2010) when a survey of Improved Traditional *Garification* Methods (ITGMs) in use was carried out in 50 *gari* factories across five states (Ekiti, Ondo, Ogun, Osun and Oyo) of south-western Nigeria. These were grouped into eight (ITGM I-VIII) based on operator's and workplace’s characteristics, heating process and estimated output.

   These improved fryers were designed for worker’s comfort in an attempt to eliminate or alleviate smoke hazard, heat stress, body discomforts and increase output.
   iii. Mechanized: this is a gari frying method with minimal human intervention. It attempts to
improve the frying technique and production capacity through the use of mechanical components joined together. The major problem with this method is the that there are few mechanized gari processing plants in the Nigerian market which are found to be performing well as regards the quality of gari. Although there are some new designs, they have not replaced the crude method of gari frying in the rural community. Some of these mechanized gari fryers are:

a. Newell Dunford model (designed jointly by the Newell Dunford Company in London and the Federal Institute of Industrial Research (FIIRO), Oshodi in Nigeria.)
b. Brazilian model
c. Fabrico model
d. The UNN model (with a capacity of 66kg of gari per hour)
e. The UNIBADAN model (with a capacity of 80kg of gari per hour)
f. Anambra State University Model (with a capacity of 50.4kg of gari per hour)

2. Location of workplace
   i. Outdoor: these are workplaces located outside (under sheds). They are not located in a confined area.
   ii. Indoor: these workplaces are located within a confined space.

3. Working posture
   i. Sit only: This is a posture in which the worker carries out the task sitting only. It can be divided into:
      - Sideways: This is a sitting posture in which the worker carries out the task sitting sideways relative to the fryer.
      - Frontal: This is a sitting posture in which the worker carries out the task sitting and facing the fryer directly.
   ii. Stand only: This is a posture in which the worker carries out the task standing only.
   iii. Sit and stand: This is a posture in which the worker carries out the task alternating between sitting and standing.

Samuel (2008) classified the working postures as stand only, sit and stand, sideways and frontal.

Ferrar (1992) described a typical gari preparation area as consisting of a large, open-sided shed, often poorly ventilated workplace. Many women work in these sheds, often with children around them. Igbeka (1995) reported that a typical gari fryer comprises; shallow earthenware and aluminium or iron cast fryers. He also added that in certain parts of Nigeria, an oil drum, cut longitudinally and set into a specially prepared fireplace, is used.

Women have dominated the activities in agricultural processing especially in cassava processing - Gari frying is not an exception. According to Samuel et al (2010), gari is fried traditionally by rural women in shallow cast iron pans over an earthenware fireplace using wood. The women use spatula-like paddles of wood or calabash sections to press the sifted mash against the hot surface of the frying pan and turn it vigorously to avoid caking. It will be ergonomically sound if the dimensions of the work pan is commensurate with the length of the worker’s arm—not the case in most crude gari frying methods.

In a survey carried out by Davies (2008) in Oyo state of Nigeria, it was observed that women undertook unit operations in cassava processing that were predominantly manual: peelings, washing, frying, sifting and drying. Women were favourably employed (about 65%) in the cassava processing centres. Davies (2008) also reported that Atala et al. (1991) made similar observation in Kaduna State Nigeria.

In Anambra State, Nsoanya et al (2011) reported that majority of cassava processors in Anambra-East Local Government were females (85.0%) who traditionally are known to play more active role in cassava production, processing, storage and marketing. They further discovered that majority (60.0%) of them were aged between 31 – 40 years, with a mean average age of 37.5, implying that the cassava producers were relatively young.

Cassava processing is a dominant activity in Ifo Local Government area, especially in Ibogun where
virtually every family is involved in processing cassava into either *gari* or *fufu*. These products are either consumed by the family or sold at various markets within the area. The method of transporting cassava from the farms to the processing sites (usually their houses) is usually manual. The cassava tubers are packed in sack bags and are carried manually or with a motorcycle when affordable. The peeling of the cassava is usually done manually (with knives) whereby family and friends come together to peel the cassava. Although cassava grating is mechanized, very few of the machines are available and are owned by individuals who operate them for business purposes; cassava tubers would have to be transported to and fro the processing sites for grating.

At the pressing stage of the processing; very few people could afford the screw press. Those who don’t have access to the screw press (or couldn’t afford the fee required by the owners of the press) usually make use of heavy objects (e.g. stones, scrap machine parts, log of wood etc.).

*Gari* frying sheds are usually sited within the living environment (mostly in front or at the back of their houses). Apart from using these sheds for *gari* frying, these sheds also serve as their kitchen. The owners of these sheds also rent it out to other processors. Even though there are people who are hired to fry the *gari*, the wives of the cassava farmers usually know how to fry *gari* without any special training.

This paper is aimed at revealing the characteristics of a typical *gari* frying site in Ifo Local Government area of Ogun state, Nigeria. These characteristics include the characteristics of the frying method, work place characteristics, utensils and that of the worker. The efficiency and the output of these work stations are not considered in this paper.

**Methodology**

The sample population is Ifo Local Government area in Ogun state which is located in the south-western part of Nigeria. This area includes Ifo town and Ibojun villages. The populace is actively involved in the cultivation and processing of cassava.

The population to be investigated was an infinite population whose exact numerical strength cannot be estimated, the number of *gari*-frying workstations in Ifo Local Government area would continue to vary (i.e. increase or decrease). Workstations can spring up or be shut down at any time depending on the quantity of cassava available, financial strength, the demand for *gari* and whether or not to process cassava into *gari* or other products.

Judgment sampling technique was used in this work. This sampling method is a non-probabilistic sampling method. Forty samples (workstations) were selected from the *gari*-frying population. These selected workstations were visited and investigations were made to identify the following different features and characteristics;

1. **Method**
   i. Crude ($A_1$)
   ii. Improved ($A_2$)
   iii. Mechanized ($A_3$)

2. **Location of workplace**
   i. Outdoor ($B_1$)
   ii. Indoor ($B_2$)

3. **Pan Shape**
   i. Circular ($C_1$)
   ii. Trapezoidal ($C_2$)
   iii. Others ($C_3$)

4. **Working posture**
   i. Sit only ($D_1$)
      a. Sideways ($E_1$)
      b. Frontal ($E_2$)
   ii. Stand only ($D_2$)
   iii. Sit and stand ($D_3$)

5. **Worker**
   i. Female ($F_1$)
   ii. Male ($F_2$)

6. **Worker’s age**
   i. 15 - 25 years ($G_1$)
   ii. 26-40 years ($G_2$)
   iii. 40 and above ($G_3$)

7. **Worker’s experience**
   i. 16 years and above ($H_1$)
   ii. 6 – 15 years ($H_2$)
   iii. 5 years and below ($H_3$)

8. **Worker’s disability**
   i. None ($I_1$)
   ii. Disabled ($I_2$)

A combination of the above characteristics would characterize a particular *gari*-frying workstation. Probability tree analysis was used in determining the prevalent features of the workstations where each feature was taken to represent an event. Probability tree was used to combine this features
so has to generate the characteristics of a particular workstation, worker and their likely posture at work. Based on these, a typical gari frying workstation, worker and the typical work posture will be the combinations with the highest probability of occurrence.

Mathematically,

$$p(N_x) = \frac{n(N_x)}{\sum_{x=1}^{k} N_x}$$

(1)

Where:

- $N_x$ = Specific feature to be identified (e.g. A1, B2, C3, I2, etc.)
- $n(N_x)$ = The number of times the feature was identified
- $\sum_{x=1}^{k} N_x$ = Summation of the number of times each of the feature was identified.
- $p(N_x)$ = Probability of identifying a particular feature.

Hence, the probability of identifying some set of features to characterize a workstation can be given as;

$$P(T) = p(N_1) \times p(N_2) \times p(N_3) \times \cdots \times p(N_k)$$

(2)

Statistical analysis was performed on the measured arm length and the mean pan distance. Excel 2010 (Analysis Tool Pack) to determine the correlation coefficient between the two variables. While SPSS 20 was used to test the hypothesis (t-test) based on the following criteria:

$H_0$: there is no positive relationship between the measured arm length and the mean pan distance.

$H_1$: there is positive relationship between the measured arm length and the mean pan distance.

Decision: Accept $H_0$ if $t_{0.05} < t_{\text{cal}}$, that is, the ergonomic parameter (arm length) has no effect in determining the design parameter of interest (mean pan distance). Hence $H_1$ is rejected;

Accept $H_1$, if $t_{0.05} > t_{\text{cal}}$, that is, the ergonomic treatment (arm length) has a positive effect in determining the design parameter of interest (mean pan distance). Hence $H_0$ is rejected.

Where: $t_{0.05}$ is the test statistic from the table at 5% under the degree of freedom (df) while $t_{\text{cal}}$ is the test statistic calculated by the software.

**Results and discussion**

**Elements of the Gari-Frying Task**

From the pilot study, it was discovered that the gari-frying process could be divided into three main tasks excluding the activities that took place before and after frying which were mostly transportation, cooling, sifting and packaging activities. These tasks include loading, stirring and unloading.

1. **Loading**: This is the stage during which the pressed cassava mash would be scooped into the pan for frying. This task continues as long as there is still cassava mash available for frying. Usually about 4-5 scoops are poured into the pan for frying depending on the size of the pan.

2. **Stirring**: This is the stage that comes mostly after loading. It requires continuously turning the gari in the pan while frying so as to avoid caking. This continuous process requires stirring for the period a particular batch in the pan would last, that is, cook and dehydrate.

3. **Unloading**: This stage involves the removal of the fried gari from the pan into a container.

**Description of a typical gari-frying station**

From the results gathered, the probability of occurrence for various possible combinations of the characteristics pertaining to gari frying workstations in Ifo Local Government area is as stated in figure 2. Since no mechanized gari-fryer was identified during the survey, A3 was isolated from the analysis. The probability tree analysis shows that a typical gari frying workstation in Ifo Local Government area will have the characteristics A1B1C1 (i.e. crude and locally made; located outdoor and has a circular frying pan). This has a high probability of occurrence of about 0.975.

A typical local gari fryer consists of a frying chamber constructed with earth material such as mud, stone etc., carved out underground. On the
frying chamber is seated a pan for frying the *gari* which were all circular in shape with an average diameter of 64.3 cm; the local *gari* fryers located outdoors are usually under a shed; the improved *gari* fryer identified was designed for two people; it is trapezoidal in shape and has a chimney which directs the smoke to the atmosphere. This improved *gari* fryer was found at Ibogun Olaogun village in a *gari* production factory. It is not fully in use and could be abandoned at any time.

Figure 2: Probability Tree Analysis–Workstation Characteristics

**Posture at work**

Though Samuel (2008) identified four working postures of *gari* fryers in the south-western part of Nigeria which are “sitting sideways”, “front sitting”, “stand only” and “sit and stand”, only the “sit only” (which includes sitting sideways and front sitting postures) and “sit and stand” working positions were identified in the area under study. There were no location with “stand only” working posture.

From the survey conducted, the probability of occurrence for various possible working postures taken in *gari* frying workstations in Ifo Local Government area is as revealed in figure 3. It was discovered that 97.5% of the population used the “sit only” working position. These were all sighted at the local *gari*-frying locations visited; this implies that all the local *gari*-frying sites use the “sit only”
method. On the other hand, about 2.5% of the population alternates between sitting and standing. This also is peculiar to the improved gari-frying locations visited. One of the postures identified was the D₁E₂ (i.e. front sitting) which accounted for about 24.4% of the entire population. The remaining few workers investigated took sideways postural pattern.

Hence the typical working posture is D₁E₁ (i.e. sitting sideways) with a probability of 0.71.

\[ \begin{align*}
D_1 & \quad 0.975 \\
D_2 & \quad 0.025 \\
D_3 & \quad 0 \\
E_1 & \quad 0.75 \\
E_2 & \quad 0.25
\end{align*} \]

Figure 3: Probability Tree Analysis–Working Posture

Workers

From the survey conducted it was discovered that those involved in gari frying within the study area were not having any form of physical disability and they have an average arm’s length of 67.7cm; 87.5% of which were female which confirms the dominance of women in gari frying as identified by Davies et al., (2008), Igbeka (1995), Ferrar (1992) and others. It was also discovered that 50% of the population were above the age of 40 years, all of which were female. 40% were between the ages of 26 and 40 years.

The probability of occurrence for various possible combinations of the characteristics pertaining to people frying gari in Ifo Local Government area is as stated in figure 4. Since none of the workers was observed to be disable when this investigation was carried out, the disability section (I) was excluded from the analysis. From the population; F₁G₁H₁ (i.e. female above 40 years of age and gari frying experience of over 16 years) are dominant with a probability of 0.419. Another peculiar part of the population which cannot be neglected is F₁G₃H₃ (i.e. female between the age of 15 and 25 years with gari frying experience below 5 years) which accounted for 25.4% of the entire population. From further investigations, it was discovered that most of the male found during the survey were predominantly not a full time gari fryer and were actually assisting their mother or wife.
Figure 4: Probability Tree Analysis–Worker’s Characteristics
Table 1: Correlation between Arm Length and Pan Mean Distance

<table>
<thead>
<tr>
<th></th>
<th>Arm Length</th>
<th>Pan Mean Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean</td>
<td>67.725</td>
<td>64.295</td>
</tr>
<tr>
<td>Variance</td>
<td>11.38397</td>
<td>40.62715</td>
</tr>
<tr>
<td>Observations</td>
<td>40</td>
<td>40</td>
</tr>
<tr>
<td>Pearson Correlation</td>
<td>-0.03965</td>
<td></td>
</tr>
</tbody>
</table>

Table 1 and figure 8 show that the Pearson’s correlation coefficient between the Length of the worker’s arm and the mean distance of the pan is -0.03965, which is small and of a negative correlation. This implies that there is no virtual relationship between the two variables and if it does exist, it is negative. This further reveals that the length of the arm of the workers involved in gari frying was not considered while choosing the size of the pan to be used. The crude method of frying gari is clearly not ergonomically sound.

Table 2: Paired sample t-test

<table>
<thead>
<tr>
<th>Paired Differences</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Lower</td>
</tr>
<tr>
<td>Mean</td>
<td>3.4300</td>
</tr>
<tr>
<td>Arm Length – Pan Mean Distance</td>
<td>t_cal</td>
</tr>
<tr>
<td></td>
<td>0</td>
</tr>
</tbody>
</table>

Table 2 shows the result of hypothesis test using the correlation coefficient. Since $t_{0.05} < t_{cal}$, $H_0$ is accepted and $H_1$ is rejected, i.e. the ergonomic parameter (arm length) has no effect in determining the design parameter of interest (mean pan distance).

Based on these results, the characteristics of a typical gari-frying station in Ifo Local Government Area can be identified as follows;

1. Outdoor location of workstation
2. Locally made frying chamber
3. Circular frying pan with average diameter of 64.3cm
4. Female workers with no disability
5. Worker’s arm length of 67.7cm
6. Workers are above youthful age
7. Workers have gari-frying experience of more than 16 years
8. Workers sit sideways while frying gari

**Conclusion**

This paper further reveals the dominance of traditional methods of processing agricultural products in rural areas and the dominance of women in gari frying. In Ifo Local Government area, the method of frying gari is relatively crude; very few processors have access to the very few improved
gari fryers available. Hence, Ifo Local Government Area is far behind considering the various improved traditional methods of gari frying identified in various parts of south-western Nigeria by several researchers. These improved methods are better than the crude method both in terms of production capacity and ergonomic consideration; there is therefore an urgent need to introduce various improved gari fryers into Ifo Local Government Area.

Figure 5: Distribution of Gari Frying Workers with Age.

Figure 6: Distribution of gari frying methods with the workstation characteristics
Figure 7: Distribution of *Gari* Frying Method with Postures.

Figure 8: Scatter Diagram Relating Worker’s Arm Length to Work Pan Mean Distance
Plate 1: A Worker Using the Front Sitting Posture

Plate 2: A Female Worker Sitting Sideways

Plate 3: An Improved Gari Fryer in
Plate 4: A Male Worker Using the Frontal Posture

References


