# Occupational Effect of Garri Processing on some Biochemical and Haematological Parameters among Chronic Processors in Amassoma, Bayelsa State, Nigeria

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DOI: 10.56201/ijhpr.vol.10.no2.2025.pg43.65

***Abstract***

*Garri processing is a technique for converting cassava roots into garri, a granular flour with a range of textures derived from cassava tubers. This study aims to investigate the occupational effect of garri processing on some biochemical and haematological parameters among chronic processors in Amassoma, Bayelsa State, Nigeria. Ten millilitres of blood samples were obtained via venipuncture technique from eighty garri processors, who were categorised into experimental group one, comprising forty processors with < 10 years processing experience and experimental group two, consisting of forty processors with 10-15 years processing experience. The control group consisted of fifteen non-garri processors. Five millilitres of the blood samples were dispensed into lithium heparin anti-coagulated bottle for the measurement of the following biochemical parameters: alanine aminotransferase, aspartate aminotransferase, creatinine, urea, C-reactive protein, interleukin-6, malondialdehyde and glutathione peroxidase while the remaining five millilitres were dispensed into ethylene diamine tetraacetic acid anti-coagulated bottles for the measurement of the following haematological parameters: packed cell volume, haemoglobin, total white blood cell count, neutrophil count, lymphocyte count, eosinophil count, monocyte count and basophil count employing SPSS version 23.0 for statistical analysis. In experimental group one, the findings indicated increases in the mean values of the following biochemical parameters: C-reactive protein (p=0.03), interleukin-6 (p = 0.03), malondialdehyde (p = 0.03) and glutathione peroxidase (p = 0.03) while the other parameters were not significantly altered (p > 0.05) as compared to the control group. In experimental group two, alanine aminotransferase (p = 0.04), aspartate aminotransferase (p = 0.04), C-reactive protein (p = 0.01), interleukin-6 (p = 0.01), malondialdehyde (p = 0.02) and glutathione peroxidase (p = 0.02) were significantly elevated while creatinine (p = 0.62) and urea (p = 0.71) were not significantly altered when compared with the control group. The measured haematological parameters in experimental group one revealed significant decrease in packed cell volume (p = 0.04) and haemoglobin (p = 0.04) as well as in experimental group two participants: packed cell volume (p = 0.03) and haemoglobin (p = 0.03) as compared to the control group. However, the other measured haematological parameters in experimental group one: white blood cell count (p=0.03), neutrophil (p = 0.03), lymphocyte (p = 0.03), and erythrocytes sedimentation rate (p = 0.03) as*

*well as in experimental group two participants: total white blood cell count (p = 0.01), neutrophil (p = 0.01), lymphocyte (p = 0.01), and erythrocytes sedimentation rate (p = 0.02) revealed significant elevations when compared to the control group. This study concludes that prolonged garri processing for 10-15 years may alter certain biochemical and haematological parameters. Therefore, individuals engaged in frequent and prolonged garri processing are advised to undergo routine check-ups to monitor their biochemical and haematological blood parameters*

***Keywords:*** *Occupational effect, garri processing, biochemical parameters, haematological parameters, chronic processors, Amassoma, Bayelsa State, Nigeria*

## 1. INTRODUCTION:

Garri, a derivative of cassava, is a product obtained from the processing of cassava tubers (Abass *et al.,* 2013). The processors are individuals engaged in the conversion of cassava tubers into garri, a staple cuisine in Nigeria. (Makanjuola *et al.,* 2012). Cassava, scientifically designated as Manihot esculenta crantz, is a root vegetable and the third-largest source of food crop in tropical regions, following rice and maize. The United Nations Food and Agriculture Organisation (FAO) identifies it as a significant staple food in the developing world, supplying a fundamental diet for about 500 million individuals. It is among the most drought-resistant crops, capable of thriving in marginal soils. Nigeria is the foremost producer of cassava globally, however Thailand holds the position of the greatest exporter of cassava starch (FAO, 2013).

In Nigeria, the majority of cassava roots are employed for human consumption. This crop is transformed into products such as fufu, garri, tapioca, flour, abacha, lafun, chips, bread, and various confectioneries; its secondary applications include industrial usage, animal feed, starch, glue, ethanol, and biogas (Okogbenin *et al,* 2012). Among all the aforementioned cassava products, garri is the most prevalent and constitutes the primary meal for the majority of individuals in several West African nations, particularly in Nigeria (Sherifat and Wunmi, 2018).

Garri is a convenient food due to its affordability, ease of storage, and simplicity of preparation. The procedure of preparing garri entails multiple phases as follows: The cassava roots are picked, peeled, and subsequently grated or crushed to remove the pulp, which is then fermented for several days to diminish the cyanide concentration and enhance the flavour of the garri. Post-fermentation, the pulp is subjected to pressing to extract surplus water, and the resultant mash is filtered to distinguish fine particles from coarse ones. The coarse particles are subsequently roasted in a big skillet or pot until they attain a dry and crispy texture. The end product is garri, which has a prolonged shelf life and may be utilised to prepare a variety of cuisines (Cock and Connor, 2021).

Despite its advantages for humans, the conversion of cassava into garri entails numerous environmental and occupational risks for both processors and consumers (Alimi and Animashaun, 2024). Garri processing in this region is exceedingly labour-intensive due to the rudimentary techniques employed, as it is conducted at an artisanal level (Fosu-Mensah *et al.,* 2021). The intrinsic issues of this procedure encompass pain from heat, the operator's sitting posture, and

recurrent strain from overexertion. The technique may also induce body and eye irritation intermittently, as the roasting during garri processing, utilising wood as a fuel source, exposes workers to considerable concentrations of particulate matter and smoke (Okwor *et al.,* 2017). Wood smoke comprises a variety of solids, liquids, and gases that vary with time and temperature, interacting with other pollutants, water vapour, and surfaces. The heat and smoke generated from the continuous frying of garri may adversely affect the blood. Extended exposure to heat and smoke can result in oxidative stress and the introduction of deleterious chemicals into the bloodstream (Omolola *et al.,* 2020). This may lead to inflammation, vascular injury, and changes in blood chemistry and haematological markers. Similar to tobacco and cigarette smoke, wood smoke comprises hazardous pollutants such as carbon monoxide (CO), respirable particulate matter, nitrogen dioxide, benzene, and other free radicals that may induce cancer and other health risks (Munyao *et al.,* 2022).

Nevertheless, despite these findings, garri processors continue to engage in this industry locally, disregarding the detrimental health effects. This study which focused on the occupational effect of garri processing on some biochemical and haematological parameters among chronic processors is highly pertinent.

## 2. MATERIALS AND METHODS

### 2.1 Experimental Scope

The research was carried out in Amassoma, situated in Bayelsa State. Amassoma is situated in Latitude 4° 55' 36.30" North and Longitude 6° 16' 3.50" East. The area is 1,698 km², with a population of 352,285 according to the 2006 census (Daupamo, 2018 and Egoro, *et al.,* 2024)

### 2.2 Ethical Authorisation

This research was conducted in accordance with the World Medical Association of Helsinki Declaration of 1975, as revised in 2008, following the acquisition of oral informed permission from all participants and ethical approval from the College of Health Research Ethical Committee (World Medical Association Declaration of Helsinki 2008).

### 2.3 Criteria for Inclusion and Exclusion

#### 2.3.1 Inclusion Criteria

All the ostensibly healthy participants utilised for this study exhibited no health concerns.

#### 2.3.2 Exclusion Criteria

Individuals addicted to drugs, cigarette smoking, and snuffing were excluded from this study.

### 2.4 Sample Size Determination

The study population which consisted of forty-five ostensibly healthy participants, categorised into the following groups was calculated using Taro Yamane formula: $n=N / (1+Ne^2)$ as described by

Egoro *et al.,* 2024

n=sample size

N=population of study

e=margin error

$n=100 / (1+100 (0.05)^2$

n=100 / 1+100 (0.0025)

n=100 / 1+0.25

n=100 / 1.25

n=80

### 2.4.1 Control Group

This group consisted of forty ostensibly healthy individuals, aged 43 to 61 years, who are not engaged in garri processing.

### 2.4.2 Experimental Group One

This group comprised forty seemingly healthy individuals aged 43 to 61 years, who have been engaged in garri processing for less than ten years.

### 2.4.3 Experimental Group Two

This group comprised forty ostensibly healthy individuals aged 43 to 61 years, who have been engaged in garri processing for a duration of 10 to 15 years.

## 2.5 Sample Collection and Processing

Ten millilitres of blood specimens were collected from each participant in both the control and experimental groups through venipuncture technique. Five millilitres were then transferred into their respective lithium heparin and ethylene diamine-tetraacetic acid anticoagulated containers. Each specimen was mixed homogeneously to prevent clotting and subsequently utilised for the quantitative measurement of the following biochemical parameters: alanine aminotransferase, aspartate aminotransferase, creatinine, urea, C-reactive protein, interleukin-6, malondialdehyde, and glutathione peroxidase, as well as the following haematological parameters: packed cell volume, haemoglobin, total white blood cell count, differential white blood cell count (neutrophil, lymphocyte, eosinophil, monocyte and basophil) and erythrocyte sedimentation rate

## 2.6 Laboratory Analysis of the Biochemical Parameters

### 2.6.1 Measurement of Alanine aminotransferase level

The colorimetric method earlier described by Randox Laboratories Limited, 55, Diamond Road, Crumlin, County Antrim, BT294QY United Kingdom and subsequently modified by Egoro *et al.,* 2023 was used

**Principle**

Alanine aminotransferase is measured by assessing the level of pyruvate hydrazone that is formed with 2, 4-dinitrophenylhydrazine.

α - oxoglutarate + L-alanine $\xrightarrow{GPT}$ L- glutamate + pyruvate

**Procedure**

Two test tubes, designated reagent blank (B) and test (T), were placed on a rack and labelled accordingly. Pipette 100µl of distilled water into the test tube designated B while 100µl of plasma were pipetted into a test tube designated T. In each of the test tubes designated B and T, 500µl of alanine aminotransferase (ALT) reagent 1 was added. The tubes were gently spun to mix the contents, and the mixture was incubated at 37°C for 30 minutes. Five hundred microliter of alanine aminotransferase (ALT) reagent 2 was added to both tubes respectively, which were then mixed and left to stand at room temperature for 20 minutes. Following this, 5ml of 0.4M sodium hydroxide was added to each tube, which were then mixed. After five minutes, the absorbance was measured against a blank reagent at a wavelength of 546 nm. The alanine aminotransferase (ALT) levels in the unknown test samples were extrapolated from the generated calibration curve

**Calculation**

The activity of alanine aminotransferase (ALT) in the plasma sample was read from the as shown below

Activity of Alanine Aminotransferase

| Absorbance | U/I | Absorbance | U/I | Absorbance | U/l | Absorbance | U/l |
|---|---|---|---|---|---|---|---|
| 0.025 | 4 | 0.125 | 21 | 0.225 | 39 | 0.325 | 57 |
| 0.050 | 8 | 0.150 | 25 | 0.250 | 43 | 0.350 | 62 |
| 0.075 | 12 | 0.175 | 29 | 0.275 | 48 | 0.375 | 67 |
| 0.100 | 17 | 0.200 | 34 | 0.300 | 52 | 0.400 | 72” |

**2.6.2 Measurement of Plasma Aspartate Aminotransferase**

This measurement was carried out in accordance with the described method by Randox Laboratories Limited, 55, Diamond Road, Crumlin, County Antrim, BT294QY, United Kingdom which was subsequently modified by Egoro *et al.,* 2023

**Principle**

Aspartate aminotransferase is measured by monitoring the concentration of oxaloacetate hydrazone formed with 2,4-dinitrophenylhydrazine.

α-oxoglutarate + L-aspartate $\xrightarrow{\text{GOT}}$ L-glutamate + Oxaloacetate

**Procedure**

Two test tubes, designated reagent blank (B) and test (T), were placed on a rack and labelled accordingly. Pipette 100 µl of distilled water into the test tube designated B. 100 µl of plasma were pipetted into a test tube designated T. In each of the test tubes designated B and T, 500 µl of aspartate aminotransferase (AST) reagent 1 was added. The tubes were gently spun to mix the contents, and the mixture was incubated at 37°C for 30 minutes. Five hundred microliter of aspartate aminotransferase (AST) reagent 2 was added to both tubes, which were then mixed and left to stand at room temperature for 20 minutes. Following this, 5 ml of 0.4M sodium hydroxide was added to each tube and mixed. After five minutes, the absorbance was measured against a blank reagent at a wavelength of 546 nm. The aspartate aminotransferase (AST) levels in the unknown test samples were extrapolated from the calibration curve as shown below

**Calculation**

The activity of aspartate aminotransferase (AST) in the plasma sample was read from the Table as shown below

Activity of Aspartate Aminotransferase

| Absorbance | U/I | Absorbance | U/I | Absorbance | U/l | Absorbance | U/l |
|---|---|---|---|---|---|---|---|
| 0.020 | 7 | 0.060 | 19 | 0.100 | 36 | 0.140 | 59 |
| 0.030 | 10 | 0.070 | 23 | 0.110 | 41 | 0.150 | 67 |
| 0.040 | 13 | 0.080 | 27 | 0.120 | 47 | 0.160 | 76 |
| 0.050 | 16 | 0.090 | 31 | 0.130 | 52 | 0.170 | 89 |

**2.6.3 Measurement of Creatinine Level**

The Jaffe reaction method earlier captured in the manual of Randox Laboratories Limited, 55, Diamond Road, Crumlin, County Antrim, BT294QY, United Kingdom and subsequently modified by Egoro *et al.,* 2023 was used

**Principle**

In an alkaline media, creatinine interacts with picric ions to generate a red orange complex; the intensity of the colour is directly proportional to the creatinine content in the sample. This is detected by spectrophotometry at a wavelength of 520 nm.

**Procedure**

Three test tubes were set up in a rack labeled reagent blank (B), standard (S) and test (T). One thousand microliter (1000µl) of working reagent was pipette into all the respective tubes. One hundred microliter (100µl) of standard was pipette into test tube labeled S and one hundred microliter (100µl) of sample added to test tube labeled T. The content in each tube was gently swirled to ensure proper mixing and after 30 seconds the absorbance of both the standard and sample was read as A1. The contents in both test tubes were read again as A2 exactly after 2 minutes at 520 nm wavelength.

**Calculation**

$$\frac{\text{Absorbance of sample} \times \text{Concentration of standard}}{\text{Absorbance of standard}} = \text{Concentration of creatinine (µmol/L)}$$

**2.6.4 Measurement of urea level**

The urease berthelot's method as reflected in the manual of Randox Laboratories Limited , 55, Diamond Road, Crumlin, County Antrim, BT294QY, United Kingdom and modified subsequently by Egoro *et al.,* 2023 was used

**Principle**

The enzyme urease hydrolyzes plasma urea into two molecules of ammonium and carbon iv oxide. The ammonium then interacts with a phenolic chromogen and hypochlorite to generate a green-colored complex. The intensity of colour measured at 540 nm is directly proportional to the sample's urea content.

**Procedure**

Three test tubes were designated reagent blank (B), standard (S), and test (T) and placed on a rack. One thousand microliters of working reagent was separately dispensed into each of the three indicated tubes. Ten microliters of the standard were pipetted into the S-labeled test tube. The sample volume of 10µl was pipetted into the T-labeled test tube. The tubes were gently spun to mix the contents, and the mixture was incubated for 5 minutes at 37ºC. Following the addition of 1000 µl of chromogen reagent to each of the three test tubes designated B, S, and T, the contents were incubated at 37ºCfor 5 minutes in a water bath. After five minutes, the absorbance against the reagent blank was measured at 540nm wavelength.

**Calculation**

$$\frac{\text{Absorbance of sample} \times \text{Concentration of standard}}{}$$

Absorbance of standard

= Concentration of urea (mmol/l)

### 2.6.5 Measurement of C-reactive protein level

Latex turbidimetry method described by Spin-react Diagnostic kit and modified by Emmanuel *et al* 2020 was adopted

**Principle**

CRP-Turbilatex is a quantitative turbidimetric assay for measuring C-reactive protein in serum or plasma from laboratory animals or humans. When combined with a sample containing C-reactive protein, latex particles coated with particular anti-human C-reactive protein agglutinate. The absorbance change is due to agglutination, which is reliant on the C-reactive protein content of the patient sample, which is assessed using a calibrator with a known C-reactive protein concentration

**Procedure**

Two different clean cuvettes were labeled sample (S) and calibrator (C) respectively. One thousand microliter (1000µl) of working reagent was added to both cuvettes labeled S and C respectively. Five hundred microliter (500µl) of sample was added to cuvette labeled S and five hundred microliter (500µl) of calibrator was added to the cuvette labeled C.

The content in each cuvette were mixed and absorbance (A1) measured immediately at 540 nm wavelength after adjusting the spectrophotometer to zero absorbance with distilled water and second absorbance measurement (A2) was taken after 2 minutes

**Calculation**

$$\frac{(\text{Absorbance of A2 - Absorbance of A1) sample}}{(\text{Absorbance of A2 - Absorbance of A1) calibrator}} \times \text{Concentration of calibrator}$$

= Concentration of C- reactive protein (mg/L)

### 2.6.6 Measurement of Interleukin-6 level

Elascience method with catalogue number E-EL-HO. 102 and further modified by Egoro *et al.*, 2023 was adopted

**Principle**: ELISA which is an immunological technique is used to detect and quantify interleukin-6 protein in a sample of blood via generating a standard curve and interpolating the sample concentration on the standard curve in order to determine the corresponding interleukin-6 concentration

**Procedure**

Fifty microliter of plasma sample was added to each of the 96 well of ELISA plate coated with anti-interleukin-6 antibodies, followed by its incubation for 2 hours at room temperature. After this, 100 µl of enzyme-conjugate and interleukin-6 antibodies were added to each well. This content was now incubated at room temperature for one hour. This was followed by the addition of 100 µL substrate solution to each of the wells with the subsequent incubation at room temperature for 30 minutes and absorbance read at 450nm wavelength with the aid of an ELISA reader. The concentration of interleukin-6 in pg/ml was calculated via a standard curve which was generated from known interleukin-6 concentrations

### 2.6.7 Measurement of Malondialdehyde level

The ultraviolet method as described by Bio-diagnostic, 29, Tahreer Street, Dokki, Giza, Egypt and modified by Egoro *et al.,* 2024 was adopted

**Principle**

The idea relies on the precipitation of serum proteins by trichloroacetic acid, followed by centrifugation to separate the supernatant. The malondialdehyde in the serum has now formed a compound with thiobabituric acid. The intensity of the complex detected at a wavelength of 534nm is proportional to the sample's malondialdehyde content.

**Procedure**

Two test tubes were separately labelled test and blank. In each tube, one millilitre of serum and one millilitre of distilled water were added. One millilitre of reagent 1 was added to each individual test tube. One millilitre of reagent 2 was added to each individual test tube. One millilitre of reagent 3 was put to each individual tube. The contents of each tube were well combined, placed in a water bath containing boiling water for 15 minutes, then allowed to cool and stand at room temperature for 20 minutes. The tubes were then centrifuged for 15 minutes at 2,000 rpm. The separated layer was then transferred to another tube and measured using a spectrophotometer at 534 nm.

**Calculation**

$$\frac{\text{Absorbance of test} - \text{Absorbance of blank}}{1.56} = \text{Concentration of MDA (µmol/ml)}$$

### 2.6.8 Measurement of Glutathione Peroxidase level

The ultraviolet method as described by Bio-diagnostic, 29, Tahreer Street, Dokki, Giza, Egypt and modified by Egoro *et al.,* 2024 was adopted

**Principle**

Oxidation of reduced glutathione (GSH) by disulfide glutathione peroxidase reduces organic peroxide ROOH (GSSG). It's a two-step process: First, the glutathione that has been oxidised is

reduced by glutathione reductase and NADPH, resulting in the formation of NADP+ (decreased absorbance at 340nm) and the recycling of the reduced glutathione. The decrease in absorbance is precisely proportional to glutathione peroxidase concentration.

**Procedure**

Two test tubes were labeled test and blank followed by dispensing of 0. 01ml of serum and 0.01ml of distilled water into each tube respectively. One milliliter of 0.1% phosphatebuffer (R1) was added to each tube respectively followed by the addition of 0.1 ml of NADPH (R2) to each tube and 0.1ml of hydrogen peroxide (R3) as well. The content in each tube was mixed thoroughly by shaking gently. Thereafter the rate of decrease in the absorbance was recorded at 340nm/minute over a period of 3 minutes against distilled water whichis directly proportional to the glutathione peroxidase activity in the sample.

**Calculation**

$$\frac{\text{Absorbance / minute}}{0.00622 \times 121} = \text{Glutathione peroxidase concentration (µmol/L)}$$

**2.7 Laboratory Analysis of the Haematological Parameters**

**2.7.1 Measurement of Packed Cell Volume**

Microhaematocrit method as described by the International Council for Standardization in Haematology (ICSH) 1980 was used

**Principle:** The principle is based on the separation of the components of blood via centrifugation. As the blood sample is centrifuged, the heavier red blood cells settle at the bottom of the tube while at the top remains the lighter plasma and white blood cells, with the percentage of the blood volume occupied by red blood cells being proportional to the packed cells volume

**Procedure**

The anticoagulated tubes were filled to $^{2}/_{3}^{rd}$ by capillary action with the dry end of the tube sealed using sealant. This was followed by placing the filled tubes in the radial groves of the microhaematocrit centrifuge, with the sealed end against the outer rim. It was then centrifuged for 5 minutes at 2,500 revolution/minute and read with a haematocrit reader

**2.7.2 Measurement of Haemoglobin Level**

Haemoglobin cyanmethaemoglobin method as described by Van Kampen and Zijistra 1961 was adopted

**Principle:** The principle is based on the oxidation of haemoglobin to methaemoglobin by ferric cyanide with the methaemoglobin finally converted to cyanmethaemoglobin by the addition of potassium cyanide. The absorbance of the cyanmethaemoglobin is now measured at 540nm wavelength with the intensity of the colour being directly proportional to the concentration of the haemoglobin pigment in the blood

**Procedure**

Twenty microliter of blood was dispensed into a test tube followed by the addition of 5 ml of modified drabkin's fluid. The content was carefully mixed and allowed to stand for 3 minutes so as to allow the complete conversion to cyanmethaemoglobin. The absorbance was now measured at 540nm wavelength with the concentration read on a calibrated curve

**2.7.3 Measurement of Total White Blood Cell Count**

This measurement was carried out in accordance with the improved Neubauer chamber tube method as described in Textbook of Medical Laboratory Technology by Baker *et al.*, 1998

**Principle:** This principle is based on the dilution of blood with a solution of acetic acid that causes the lysis of the red blood cells with no adverse effect on the white blood cells with Gentian violet added to differentiate the white blood cells.

**Procedure**

In a small tube 0.38 ml of Turk's solution was mixed with 0.02ml of blood (1:20 dilution) followed by mixing the contents very well and carefully. After this a little quantity of the content was introduced with the aid of a micropipette into the four large corner squares of the Neubauer chamber, allowed to stand for 5 minutes after which the white blood cells in each of the squares were counted and multiplied by 50

**2.7.4 Measurement of Differential White Blood Cell Count**

Automated Haematology Analyzer method as described by the Clinical and Laboratory Standards Institute (CLSI), 2018 was adopted

**Principle:** This is based on the morphology and characteristics of each of the various types of white blood cells which is identified and differentiated after staining a blood smear with Giemsa stain that contains a combination of dyes which enable it binds to different cellular components such as nucleic acids, proteins and lipids in the white blood cells, thus allowing for the differentiation of the different white blood cells.

**Procedure**

A blood smear was flooded with 1 volume of Giemsa stain diluted with 9 volume of buffer solution (1:10) and allowed the stain to act for 15 minutes, wash and differentiated with the buffer solution. Drained and dried in air at room temperature, with the back of the slide thoroughly cleaned followed by examining the smear under a microscope using x100 magnification. The percentage of each differential white blood cells was calculated after counting a total of 100 white blood cells

**2.7.5 Measurement of Erythrocyte Sedimentation Rate**

Westergren method as described by Westergren in 1921 was utilised

**Principle:** This is based on the collection of blood sample from a patient's vein via the use of a

needle and syringe, the blood sample is mixed with an 3.8% sodium citrate anticoagulant and filled into a test tube leaving between 1-2mm spaces at the top and allowed to stand vertically for one hour without disturbance. This tube is subsequently examined after the sedimentation. The measured distance from the top of the blood column to the top of the sedimented erythrocytes is proportional to the erythrocytes sedimentation rate concentration

**Procedure**

Four milliliter of blood samples was collected from each of the participants and dispensed into 1 ml of 3.8% sodium citrate anticoagulant. The content was mixed carefully to ensure homogeneity. Thereafter, 2 ml of the blood was added to Westergren tube and allowed to stand for exactly one hour at room temperature. This was followed by the measurement of the distance between the top of the plasma column and that of the red cells column which reflects the erythrocytes sedimentation rate value in mm/hour

### 2.8 Statistical Analysis

The data from this research work were presented as mean and standard deviation, analysed using the SPSS version 23.0, while differences between the control and experimental groups were evaluated using the Student's t-test. A p-value of $p < 0.05$ was deemed statistically significant.

## 3. RESULTS

The biochemical and haematological parameters evaluation among the garri processors is shown in the Tables provided below:

The outcomes of the assessed biochemical parameters in the control group and individuals from experimental group one, with lesser than ten years of garri processing experience, are presented in Table 1 below:

**TABLE 1: Mean levels of the measured biochemical parameters in the control group compared to those in the experimental group one participants**

| Parameters | Control group (n=40) | Experimental group one (n=40) | /p-value | Remarks |
|---|---|---|---|---|
| ALT (IU/L) | 6.28 ± 0.20 | 6.30 ± 0.23 | 0.81 | NS |
| AST (IU/L) | 7.14 ± 0.20 | 7.15±0.21 | 0.92 | NS |
| Creatinine (µmol/L) | 67.50 ± 1.28 | 67. 53 ± 1.31 | 0.77 | NS |

| | | | | |
|---|---|---|---|---|
| Urea (mmol/L) | 5. 23 ± 1.44 | 5.27 ± 1.48 | 0.89 | NS |
| CRP (mg/L) | 2.76 ± 1.32 | 9. 60 ± 1.73 | 0.03 | S |
| IL-6 (pg/ml) | 8.20-11.40 | 11.71 ± 1.10 | 0.03 | S |
| Malondialdyhide (µmol/L) | 3.16 ± 0.92 | 7.78 ± 1.62 | 0.03 | S |
| Glutathione peroxidase(µmol/L) | 2.15 ± 0.84 | 5.92 ± 1.81 | 0.03 | S |

**KEYS:**
ALT = Alanine aminotransferase
AST = Aspartate aminotransferase
CRP=C-reactive protein
IL-6=Interleukin 6
S=Statistically significant
NS=Not statistically significant
n=Number of volunteers

The data presented in this Table indicate that the following measured biochemical parameters alanine aminotransferase ($p = 0.81$), aspartate aminotransferase ($p = 0.92$), creatinine ($p = 0.77$) and urea ($p = 0.89$) did not show statistical significant differences when compared with the control group, while C-reactive protein ($p = 0.03$), interleukin-6 ($p = 0.03$), malondialdehyde ($p = 0.03$) and glutathione peroxidase ($p = 0.03$) revealed statistically significanr elevations, when compared with the control group.

The measured biochemical parameters for the control group and the experimental group two, consisting of participants with 10-15 years of garri processing experience, are presented in Table 2 below:

**TABLE 2: Mean levels of the measured biochemical parameters in the control group compared to those in the experimental group two participants.**

| Parameters | Control group (n=40) | Experimental group two (n=40) | p-value | Remarks |
|---|---|---|---|---|
| ALT (IU/L) | 6.28 ± 0.20 | 9.31 ± 0.84 | 0.04 | S |
| AST (IU/L) | 7.14 ± 0.20 | 10.21 ± 0.44 | 0.04 | S |
| Creatinine (µmol/L) | 67.50 ± 1.28 | 67.55 ± 1.29 | 0.62 | NS |
| Urea (mmol/L) | 5. 23 ± 1.44 | 5.28 ± 1.56 | 0.71 | NS |
| CRP (mg/L) | 2.76 ± 1.32 | 12. 60 ± 1.73 | 0.01 | S |
| IL-6 (pg/ml) | 8.62 ± 1.00 | 15.20 ± 1.93 | 0.01 | S |
| Malondialdyhide (µmol/L) | 3.16 ± 0.92 | 11.62 ± 1.87 | 0.02 | S |
| Glutathione peroxidase(µmol/L) | 2.15 ± 0.84 | 9.70 ± 1.82 | 0.02 | S |

**KEYS:**

ALT = Alanine aminotransferase

AST = Aspartate aminotransferase

CRP=C-reactive protein

IL-6=Interleukin-6

S= statistically significant

NS=Not statistically significant

n=Number of volunteers

The results from this Table showed that the mean values of alanine aminotransferase (p = 0.04), aspartate aminotransferase (p = 0.04), C-reactive protein (0.01), interleukin-6 (p = 0.01), malondialdehyde (p = 0.02) and glutathione peroxidase (p = 0.02) were statistically elevated as compared to that of the control group while the mean values of creatinine (p = 0.62) and urea (p = 0.71) were not significantly altered as compared to that of the control group

The results of the measured haematological parameters in the control group and experimental group one participants with less than ten years garri processing experience are as shown in Table 3 below:

**TABLE 3: Mean levels of the measured haematological parameters in the control group compared to those in the experimental group one participants.**

| Parameters | Control group (n=40) | Experimental group one (n=40) | p-value | Remarks |
|---|---|---|---|---|
| PCV (%) | 36.22±0.23 | 34.00±0.52 | 0.04 | **S** |
| Hb (g/dL) | 12.12 ± 0.21 | 11.20±0.38 | 0.04 | **S** |
| Total WBC (cmm) | 7,200±1.20 | 11,800±1.75 | 0.03 | **S** |
| Differential WBC | | | | |
| Neutrophil (%) | 63.00±0.74 | 72.00±0.82 | 0.03 | **S** |
| Lymphocyte (%) | 37.00±0.40 | 28.00±0.72 | 0.03 | S |
| Eosinophil (%) | NIL | NIL | NIL | NS |
| Monocyte (%) | NIL | NIL | NIL | NS |
| Basophil (%) | NIL | NIL | NIL | NS |
| ESR (mm/Hour) | 6.00±0.10 | 8.00±0.21 | 0.03 | S |

**KEYS:**

PCV = Packed cells volume

Hb = Haemoglobin

Total WBC= Total white blood cells count

Differential WBC= Differential white blood cells count

ESR= Erythrocytes sedimentation rate

n=Number of volunteers

NS= Not statisitically significant

S= Statistically significant

The results from this Table reveal that the mean values of the following haematological parameters: packed cell volume ($p = 0.04$), haemoglobin ($p = 0.04$) and lymphocytes ($p = 0.03$) exhibited statistically significant decrease in the experimental group as compared with that of the control group, while the mean values of total white blood cell count ($p = 0.03$), neutrophil ($p = 0.03$) and erythrocytes sedimentation rate ($p = 0.03$) revealed significant elevations as compared with that of the control group

The haematological parameters for both the control group and the experimental group two participants with 10-15 years of experience in garri processing, are detailed in Table 4 below:

**TABLE 4: Mean levels of the measured haematological parameters in the control group compared to those in the experimental group two participants.**

| Parameters | Control group (n=40) | Experimental group one (n=40) | p-value | Remarks |
|---|---|---|---|---|
| PCV (%) | 36.22±0.23 | 30.00±0.56 | 0.03 | **S** |
| Hb (g/dL) | 12.12 ± 0.21 | 9.80±0.40 | 0.03 | **S** |
| Total WBC (cmm) | 7,200±1.20 | 13,700±1.92 | 0.01 | **S** |
| Differential WBC Neutrophil (%) | 63.00±0.74 | 78.00 ± 0.88 | 0.01 | **S** |
| Lymphocyte (%) | 37.00±0.40 | 22.00±0.79 | 0.01 | S |
| Eosinophil (%) | NIL | NIL | NIL | NS |
| Monocyte (%) | NIL | NIL | NIL | NS |
| Basophil (%) | NIL | NIL | NIL | NS |
| ESR (mm/Hour) | 6.00±0.10 | 11.00±0.27 | 0.02 | S |

**KEYS:**

PCV = Packed cells volume

Hb = Haemoglobin

Total WBC= Total white blood cells count

Differential WBC= Differential white blood cells count

ESR= Erythrocytes sedimentation rate

n=Number of volunteers

S= Statistically significant

The results from this Table showed statistical significant decrease in the mean values of packed cell volume ($p = 0.03$) and haemoglobin ($p = 0.03$) in the experimental group two participants with 10-15 years garri processing experience when compared with that of the control group while the mean values of total white blood cells count ($p = 0.01$), neutrophil ($p = 0.01$, lymphocyte ($p = 0.01$) and erythrocytes sedimentation rate ($p=0.02$) revealed significant elevations as compared with that of the control group

## 4. DISCUSSION

Garri, which is derived from cassava is the most widely consumed cassava-based product in West Africa and several other Sub-Saharan African nations (Oluwafemi and Udeh, 2021).

This study examined the biochemical parameters in the blood of individuals involved in garri processing for lesser than ten years (experimental group one) and for those with 10 to 15 years of garri processing experience (experimental group two), as presented in Table 1 and Table 2 respectively as well as haematological parameters in blood of individuals involved in garri processing for lesser than ten years (experimental group one) and for those with 10 to 15 years of garri processing experience (experimental group two), as presented in Table 3 and Table 4 respectively.

The mean values of these biochemical markers measured, such as liver biomarkers: alanine aminotransferase ($p = 0.81$) and aspartate aminotransferase ($p = 0.92$), renal biomarkers like creatinine ($p = 0.77$) and urea ($p = 0.89$) in the experimental group one individuals with less than 10 years garri processing experience indicated no significant alterations in comparison to the control group (Table 1). These findings which suggest that there is no adverse effect on the liver and kidney of the garri processors within this category are not in alignment with previous research work of Iyanda *et al.,* 2017 (liver) and Ogbonna *et al.,* 2018 (kidney) who reported significant elevations of these parameters.

However, the mean values of C-reactive protein ($p = 0.03$), interleukin-6 ($p = 0.03$), malondialdehyde ($p = 0.03$) and glutathione peroxidase ($p = 0.03$) in this category of garri processors with less than 10 years garri processing experience revealed significant elevations as compared to the control group (Table 1). These elevations as applicable to C-reactive protein and interleukin-6 are suggestive of inflammation and are in agreement with the previous work of Igwe 2020 and Amadi 2020 respectively while that of malondialdehyde and glutathione peroxidase which are suggestive of oxidative stress are in agreement with the past works of Iyanda *et al.*, 2017 and Amadi *et al.*, 2020 respectively

As illustrated in Table 2, the participants from the experimental group two with 10-15 years of garri processing experience demonstrated that the mean values of the following liver biochemical markers: alanine aminotransferase ($p = 0.04$) and aspartate aminotransferase ($p = 0.04$) as compared to that of the control group revealed significant elevation which is indicative of adverse effect on their liver status. This finding is in alignment with the past work of Amadi *et al.,* 2020. The biomarkers of kidney, creatinine ($p = 0.62$) and urea ($p = 0.71$) in this category of garri processors which revealed no significant alteration when compared with that of the control group as further shown in this Table, indicates no adverse effect on the kidney of these processors. This finding is in agreement with the previous works of Ezejiofor *et al.,* 2019 and Nwankwo *et al.*, 2020

As further revealed in Table 2, the mean values of the measured inflammatory markers: C-reactive protein ($p = 0.01$) and interleukin-6 ($p = 0.01$) in this category of garri processors with 10-15 years garri processing experience revealed significant elevations as compared to the control group. This elevation which is in agreement with the previous work of Igwe 2020 and Amadi 2020 respectively is suggestive of inflammation

The mean values of the oxidative stress biomarkers, malondialdehyde ($p = 0.02$) and glutathione peroxidase ($p = 0.02$), showed significant elevations when compared to the control group respectively as revealed in Table 2. This finding which is a pointer to oxidative stress in this category of garri processors is consistent with the earlier studies of Iyanda *et al.,* 2017 for malondialdehyde and Amadi *et al.,* 2020 for glutathione peroxidase.

This study which also involved the analysis of haematological parameters, such as packed cells volume, haemoglobin, total white blood cell count, differential white blood cell count, and erythrocyte sedimentation rate was aimed on the evaluation of the levels and medical implications in the blood of individuals engaged in garri processing for less than ten years (experimental group one), as shown in Table 3, and those involved for 10-15 years (experimental group two), as presented in Table 4.

The haematological findings as related to garri processors with < 10 years' experience (experimental group 1) and between 10-15 years' experience (experimental group 2) as shown in Tables 3 and 4 respectively revealed decrease in the mean values of packed cell volume ($p = 0.04$) and haemoglobin ($p = 0.04$) experimental group 1 (Table 3) and packed cell volume ($p = 0.03$) and haemoglobin ($p = 0.03$) experimental group 2 (Table 4) when compared with that of the control group respectively. This finding which may be attributed to exposure to cyanide and other toxic substances during processing of garri is in alignment with the past works of Akinwumi *et al.,* 2017, Nwosu *et al.,* 2019 and Ogbodo *et al.,* 2020 is suggestive of anaemia in this category of garri producers

The mean values of total white blood cell count ($p = 0.03$), neutrophil ($p = 0.03$) and erythrocytes sedimentation rate ($p = 0.03$) in garri processors of < 10 years (experimental group 1) as shown in Table 3 as well as total white blood cell count ($p = 0.01$), neutrophil ($p = 0.01$) and erythrocytes sedimentation rate ($p = 0.02$) in garri processors with 10-15 years' experience (experimental group 2) as shown in Table 4 revealed significant elevations when compared with the control group. These findings which are in alignment with the past works of Adebayo et al., 2017 for total white

blood cell count, Akinwumi *et al.,* 2017 for neutrophil and Nwankwo *et al.,* 2020 for erythrocytes sedimentation rate are indicative of infection and inflammation. However, the mean values of lymphocytes in both the garri processors with < 10 years and between 10-15 years' experience as shown in Tables 3 and 4 respectively, revealed a significant decrease when compared with the control group. This finding which is in agreement with the past work of Ezeh *et al.,* 2018.

## CONCLUSION

This study has established that garri processing for a period of 10-15 years triggers the significant elevation of the following biochemical parameters: alanine aminotransferase, aspartate aminotransferase, C-reactive protein, interleukin-6, malondialdehyde and glutathione peroxidase with the exception of creatinine and urea which were not significantly altered. However, the study also revealed that garri processing for 10-15 years triggers the significant decrease of the following haematological parameters: packed cells volume, haemoglobin and lymphocytes count as well as significant elevation of total white blood cells count, neutrophil count and erythrocytes sedimentation rate.

From this study's findings it is therefore pertinent to conclude that garri processing for a period of 10-15 years could put the processors at the risk of hepatic disorder, inflammatory disorder, oxidative stress disorder, iron deficiency anaemia and infections due to the chronic exposure and subsequent inhalation of some chemical substances during the course of processing which would have led to accumulation in their blood..

Based on the findings it is thus recommended as follow:

i) Garri processors should be compelled to use personal protective equipment such as gloves, masks and eye protectors during the course of processing garri
ii) Garri processors should be trained on safe handling and processing of tubers of cassava
iii) Individuals in this industry should be educated on the need to ensure good ventilation in their working places so as to prevent exposure to dust and chemicals
iv) Individuals engaged in garri processing ought to periodically undergo routine laboratory tests to monitor their biochemical and haematological blood parameters, thereby effectively preventing and managing any disorders that may arise from alterations.

**Competing Interest:** None

### Contribution to Knowledge

This study has exposed to the public and garri processors the adverse health implications garri processors are prone to and the possible remedies to prevent these adverse health implications

### Acknowledgements

We sincerely acknowledge the efforts of Mr Jonathan Tamarpreyibo for linking us with the participants used for this research work. Also, Mr Tiemo Preye, Mr Johnson Jackson and Mr Collins Bina are acknowledged for their moral support during the course of this research work.

Scientist Lucky Jumbo is highly appreciated for assisting us in the blood collection from the participants. All the members of staff of Quality Medical Laboratory, Yenagoa, Bayelsa State, Nigeria are extremely appreciated for their positive contributions and cooperation during the course of this research work. Mr Ganiyu Ahmed is not left out for the time taking to type this manuscript, paraphrase and check the plagiarism percentage for us, we say a big thank you. Lastly, we seize this medium to appreciate and extend our wholehearted thanks and love to our wives and children for their cooperation and patience with us during this stressful period.

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