



## Changes in Some Biochemical Parameters and Body Weights of Healthy Albino Rats Following Palm-wine Administration

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### Authors' contributions

This work was carried out in collaboration among all authors. Author GSH designed the study, performed the statistical analysis and wrote the initial manuscript. Author OBN sourced for and supplied the experimental materials used for the study. Author BAJ managed the analysis of the study. Authors NM and RV managed the literature searches. All authors read and approved the final manuscript.

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### ABSTRACT

**Aims:** To evaluate the effect of palm-wine administration on liver function, antioxidant parameters and body weights in albino rats.

**Study Design:** Randomized block design.

**Place and Duration of Study:** Department of Biochemistry and Molecular Biology Laboratory, Nasarawa State University, Keffi, Nasarawa State, Nigeria between June and August, 2019.

**Methodology:** Twenty adult male albino rats were divided in to five groups of four rats each, group 1 was the control. The experimental groups were administered fresh and prolonged-fermented palm-wine thus; Group 2: 15ml/ of fresh palm wine, Group 3; 15ml/ kg of prolonged fermented palm wine, Group 4; 30ml/ kg of fresh palm wine, Group 5; 30 ml/ kg of prolonged fermented palm wine, for 28 days.

**Results:** AST activity decreased significantly ( $P < 0.05$ ) in groups 3 ( $9.615 \pm 0.225$ ), 4 ( $9.860 \pm 0.162$ ) and 5 ( $9.390 \pm 0.624$ ) when compared to the control ( $10.505 \pm 0.121$ ). ALT activity was observed to decrease significantly ( $P < 0.05$ ) in group 5 ( $7.415 \pm 0.548$ ) when compared to control. ALP decreased

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significantly ( $P < 0.05$ ) in group 3 ( $7.395 \pm 0.710$ ) when compared to control ( $8.250 \pm 0.577$ ). Total Bilirubin, was significantly ( $P < 0.05$ ) lower in groups 3 ( $0.120 \pm 0.041$ ) and 5 ( $0.170 \pm 0.012$ ) compared to control ( $0.650 \pm 0.012$ ). MDA decreased significantly ( $P < 0.05$ ) in groups 2, 3 and 5 compared to control. SOD decreased significantly ( $P < 0.05$ ) in group 2 ( $2.735 \pm 0.110$ ) compared to control ( $2.990 \pm 0.012$ ). Groups 4 ( $2.700 \pm 0.046$ ) and 5 ( $2.710 \pm 0.346$ ) showed significant ( $P < 0.05$ ) decrease in  $GP_x$  when compared to control. GSH was significantly ( $P < 0.05$ ) higher in groups 4 ( $5.950 \pm 0.058$ ) and 5 ( $5.925 \pm 0.064$ ) compared to control ( $3.110 \pm 0.035$ ). By the third week, the mean body weights of the rats significantly ( $P < 0.05$ ) decreased in all the groups compared to week 2.

**Conclusion:** Palm-wine did not exert remarkable toxic effect on the liver biomarkers and may not have induced oxidative stress but reduced body weights of the rats in the third week of administration.

**Keywords:** Palm-wine; biochemical parameters; antioxidants; body weights; evaluation.

## 1. INTRODUCTION

In this study, we evaluated the changes in some important metabolic markers of key metabolic organs such as the liver following oral palm-wine administration to albino rats. Palm wine is a naturally fermented alcoholic beverage obtained from the sap of various species of palm trees through a process known as palm-wine tapping. It is referred to as a natural alcohol because of the natural fermentation process it undergoes in contrast to other alcoholic beverages that undergo industrial fermentation under highly controlled industrial processes.

It is a milky alcoholic beverage commonly obtained in West Africa [1]. The wine is gotten from the sap of palm species such as *Raphia palm (Raphia looken)* and African oil palm (*Elaeis guinensis*) [2,3]. The sap becomes milky-white after fermenting due to the increased microbial suspension resulting from the prolific growth of the fermenting organisms such as *Bacillus spp*, *Streptococcus spp*, *Saccharomyces spp*, *Pischia spp*, *Leuconostoc spp*, *Micrococcus spp*, *Serratia spp*, *Aerobacter spp*, *Pseudomonas spp*, *Cornybacterium spp*, *Asppergillus spp*, and *Candida spp*. [4]. Sources of the fermenting organisms are the gourds, tapping implements and air [5].

Many people in sub-saharan Africa are known to be consumers of palm-wine. Some traditions in Nigeria such as the Igbo tradition considers palm-wine as a major drink at traditional meetings. There are many palm-wine selling joints spread across many villages and towns in Nigeria as many people prefer it to conventional beer or other alcoholic drinks.

A number of health benefits have been speculated about the natural wine such as its ability to improve sight and its potency in treating measles. Palm-wine is widely consumed at homes, in social events and during performance of traditional rites and that for some people, it enjoys a high status as a social lubricant that relieves tension, gives self confidence, blurs the appreciation of uncomfortable realities and serves as a relief to emotional and environmental stress. Little wonder that the wine may be addictive just like any other alcoholic drinks due to the temporary euphoria experienced by its consumers [6].

Despite the positive speculations about the wine, its consumption does not go well with some persons because of the manifestation of different symptoms such as headache, stomach ache, dizziness, fatigue, vomiting, general weakness of the body and fever among others, after consuming it. There has not been any regulation of tapping, selling or consumption of the wine hence the need for a research to check for possibility of any associated risk of toxicity.

## 2. MATERIALS AND METHODS

### 2.1 Materials

#### 2.1.1 Palm-wine

Freshly tapped palm wine was purchased from a local palm-wine tapper in Keffi town every morning. The fresh palm wine was collected into a plastic keg and covered loosely. It was then transported to the laboratory and stored at room temperature before the experiment.

#### 2.1.2 Experimental animals

The animals used in this study were healthy adult albino rats weighing 150g – 250g. They were

bought from University of Jos, Plateau State, Nigeria, and were transported in cages to animal house, Department of Biochemistry and Molecular Biology, Nasarawa State University, Keffi where they were acclimatized for seven (7) days and fed on normal rat chow and water *ad libitum* before the commencement of the experiment.

## 2.2 Methods

### 2.2.1 Prolonged fermentation of the palm wine

A portion of the fresh palm wine collected in the morning was transferred into a plastic container and allowed to ferment for addition ten (10) hours before it was administered to the rats. This was labelled as prolonged fermented palm wine for the purpose of this research.

### 2.2.2 Experimental design

A total of twenty (20) healthy adult male albino rats were divided into five (5) groups of four (4) rats in each group and administered the palm wine thus;

**Group 1:** Normal control (not administered palm-wine)

**Group 2:** 15ml/ kg of fresh palm wine daily

**Group 3:** 15ml/ kg of prolonged fermented palm wine daily.

**Group 4:** 30ml/ kg of fresh palm wine daily.

**Group 5:** 30ml/ kg of prolonged fermented palm wine daily.

The administration of palm wine lasted for 28 days and on the 29<sup>th</sup> day after an over-night fast, body weights of the albino rats were taken for the last time measured and blood samples were collected in to test tubes for analysis of biochemical parameters.

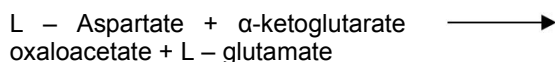
The blood samples were allowed to clot and the samples centrifuged at 3000 rpm for 5 minutes to separate the serum from other components of the blood which was then used for the analysis.

### 2.2.3 Analysis of liver function biomarkers

#### 2.2.3.1 Assay of Aspartate Aminotransferase (AST) activity

The activity of aspartate aminotransferase (AST) was determined colorimetrically according to the [7] for *in vitro* determination of GOT/AST in

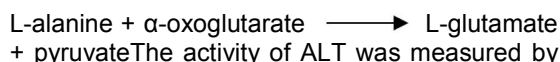
serum using Randox test kit. Aspartate aminotransferase (AST) also called glutamate-oxaloacetate transaminase (GOT) is measured by monitoring the concentration of oxaloacetate hydrazone formed with 2, 4-dinitrophenylhydrazine. The enzyme catalyses the transfer of the  $\alpha$ -amino group from aspartate to  $\alpha$ -Ketoglutarate with the release of oxaloacetate and glutamate.



The activity of AST was measured by monitoring the concentration of oxaloacetate hydrazone formed with 2,4-dinitrophenylhydrazine. Briefly, 0.5ml of reagent 1 (AST substrate solution) was put in a test tube labelled 'sample' and 0.1ml of serum added. The tube was incubated at 37<sup>o</sup>C for 30 minutes. Then 0.5ml of Reagent 2 (2, 4-dinitrophenylhydrazine) was added and allowed to stand for exactly 20 minutes at 25<sup>o</sup>C. Sodium Hydroxide (5.0ml) was also added. In another test tube labelled 'sample blank' was added 0.5ml of reagent 1 and as well incubated for 30 minutes at 37<sup>o</sup>C. Then 0.5ml of reagent 2 and 0.1ml of serum were added and left to stand for exactly 20 minutes at 25<sup>o</sup>C. Sodium hydroxide 5.0ml was added and the absorbance of the samples (A sample) read against the sample blank after 5 minutes at 546nm.

#### 2.2.3.2 Assay for Alanine Aminotransferase (ALT) Activity

The activity of alanine aminotransferase (ALT) was determined by [7] colorimetric method for *in vitro* determination of ALT in serum using Randox test kit. Alanine aminotransferase also called glutamic-pyruvate transaminase (GPT) catalyses the transfer of  $\alpha$ -amino group from alanine to  $\alpha$ -ketoglutarate with the release of pyruvate and glutamate.



The activity of ALT was measured by monitoring the concentration of pyruvate hydrazone formed with 2, 4, -dinitrophenylhydrazine which is proportional to its concentration. Briefly, 0.5ml of Solution 1 {ALT substrate solution} was put in a test tube and 0.1ml of serum added. The tube was incubated at 37<sup>o</sup>C for 30 minutes. After incubation 0.5ml of solution 2 (2, 4 -dinitrophenyl hydrazine) was added and allowed to stand for exactly 20 minutes at 25<sup>o</sup>C. Then, 5.0ml of sodium hydroxide (0.4 mol/l) was added. Solution 1

(0.5ml) was also added to another test tube labelled blank and incubated for 30 minutes at 37°C. The 0.5ml of solution 2 and 0.1ml of the serum sample were added to the tube and left to stand for exactly 20 minutes at 25 °C. Finally, 5.0 ml of sodium hydroxide was added to the test tube (blank). The contents of the test tubes were mixed and the absorbance of the samples (A sample) read against the sample blank after 5 minutes at 546 nm.

### 2.2.3.3 Assay of Alkaline Phosphatase (ALP) Activity

Optimized standard method according to the method of [8] for the *in vivo* determination of alkaline phosphatase in serum using Randox test kit was employed. Alkaline phosphatase hydrolyses p-nitrophenylphosphate to generate phosphate and p-Nitro phenol according to the equation.

$$\text{P-nitrophenylphosphate} + \text{H}^+ \rightarrow \text{Phosphate} + \text{p-nitrophenol}$$
 Briefly, after reconstituting R/b to get the reagent R1, 1.0ml of the reagent was pipetted into each test tube and 0.02 ml of the serum sample added to each tube. The reagent (R1) was mixed with the serum sample and the initial absorbance read. A stopwatch was simultaneously started. The absorbance was read again after 1, 2 and 3 minutes.

To calculate the ALP activity, the following formula was used:

$$\text{ALP activity (U/L)} = 2760 \times A_{405\text{nm}/\text{min}}$$

Where A = Change in absorbance.

### 2.2.3.4 Determination of Total Bilirubin concentration

The Total Bilirubin concentration was determined using a colorimetric method according to the method of [9, 10] as outlined in Randox ® kits for total Bilirubin estimation. Total Bilirubin reacts with diazotised sulphanilic acid in alkaline medium to form a blue coloured complex. Total Bilirubin was determined in the presence of caffeine, which releases albumin bound bilirubin, by the reaction with diazotised sulphanilic acid.

### 2.2.3.5 Determination of direct bilirubin concentration

The Direct Bilirubin concentration was determined using a colorimetric method according to the method of [9;10] as outlined in

Randox ® kits for Bilirubin estimation. Direct (conjugated) bilirubin reacts with diazotised sulphanilic acid in alkaline medium to form a blue coloured complex. Total bilirubin is determined in the presence of caffeine, which releases albumin bound bilirubin, by the reaction with diazotised sulphanilic acid. Briefly, 0.20 ml of reagent 1 was pipetted into two test tubes labelled sample Blank (B) and sample (A). A drop (0.05 ml) of reagent 2 was pipetted into the test tube containing sample (A) only. This was followed by the addition of 2 ml sodium chloride (9 g/l) into both test tubes containing sample blank (B) and sample A respectively (for direct) and 1ml caffeine for total bilirubin. Serum (0.20 ml) was finally pipetted into both test tubes, sample blank (B) and sample (A). The contents of the test tubes were mixed thoroughly and allowed to stand for exactly 5 minutes at 25°C (10 minutes for total and 1 ml R4 (tartrate) added for total bilirubin and allowed for 5 minutes. The absorbance of the sample against the sample blank ( $A_{DB}$ ) was read at 550 nm.

Direct bilirubin values were obtained from the following calculation:

$$\text{Direct bilirubin (mmol/L)} = 246 \times A_{DB} (550\text{nm})$$

$$\text{Direct bilirubin (mg/dl)} = 14.4 \times A_{DB} (550\text{nm})$$

### 2.2.3.6 Determination of Malondialdehyde (MDA) concentration

The determination of Malondialdehyde (MDA) Concentration was estimated by measuring spectrophotometrically the level of the lipid peroxidation product; Malondialdehyde (MDA) as described by [11]. Lipid degradation occurs forming such products as Malondialdehyde (from fatty acids with two or more double bonds), ethane and pentane. MDA reacts with thiobarbituric acid to form a red or pink complex, which in acid solution absorbs maximally at 532nm. Briefly, 0.1ml of serum was mixed with distilled water in a test tube, 0.5 ml of 25% TCA (trichloroacetic acid) and 0.5 ml of 1% TBA (thiobarbituric acid) in 0.3% NaOH were also added to the mixture. Then 0.1 ml of 20% sodium dodecyl sulfate (SDS) was added to the cooled solution and mixed properly. The absorbance was taken at wavelength 532nm and 600 nm against a blank.

$$\text{MDA} = \frac{A_{532}}{0.5271} - \frac{A_{600}}{0.1} \times \frac{100}{1} \text{ (mg/dl)}$$

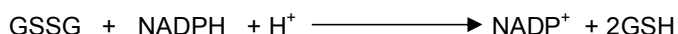
Where,  $A_{532}$  and  $A_{600}$  = Absorbance at 532 nm and 600 nm respectively.

### 2.2.3.7 Determination of Glutathione (GSH) concentration

The concentration of glutathione was determined according to the method of [12]. Two sets of test tubes were labelled Test (T) and Blank (B). Distilled water (0.1ml) was pipetted into a test tube labelled blank and 0.1ml of serum sample into the test tube (T). Known volume 0.9ml of distilled water was added to each test tubes. 0.2ml of 20% sodium sulphate was added to all the test tubes. The contents were thoroughly mixed by shaking. After 1 to 2 minutes succeeding the shaking process, 0.02ml each of 20% lithium sulphate was pipetted into test tubes respectively. Also, a known quantity of 0.2ml each of 20% Na<sub>2</sub>CO<sub>3</sub> was added to the tubes respectively and shaken vigorously. After shaking, phosphor-18-tungstatic acid (0.2ml) was added to the test tubes. The contents was mixed thoroughly and allowed to stand for 4 minutes in order to allow for colour development which was shortly followed by the addition of 2.5ml each of 2% sodium sulphate into the test tubes respectively. The absorbance was read at 650nm in less than 10minutes against a reagent blank.

### 2.2.3.8 Assay for Superoxide dismutase (SOD) activity

Superoxide dismutase activity was assayed using the method of [13] as outlined in Randox



Briefly, to 0.5ml of serum, of ethanol was added and mixed. To this mixture was added 1.0 ml of  $\alpha$ -dipyridyl solution and 1.0 ml of ferric chloride solution and mixed. The colour developed was read at 520 nm in the spectrophotometer. Values were read as mg/dl of serum from a standard.

## 2.3 Statistical Analysis

The data obtained was analyzed using one-way ANOVA with the help of IBM statistical product and service solution (SPSS) version 21.0 to get the mean values and standard deviations. Further test for level of significance was done using LSD and Duncan tests. The level of significance was set at  $P < 0.05$  for all the data.

## 3. RESULTS AND DISCUSSION

### 3.1 Results

#### 3.1.1 Effects of palm wine administrations on liver function parameters of albino rats.

As shown in Table 1, Aspartate Aminotransferase (AST) activity was observed to decrease significantly ( $P < 0.05$ ) in groups 3, 4 and 5 respectively when compared to the control group (group 1).

Kits for SOD assay. The method employs xanthine and xanthine oxidase to generate superoxide radicals which reacts with 2-(4-iodophenyl)-3-(4-nitrophenol)-5-phenyltetrazolium chloride (I.N.T) to form a red formazan dye. The superoxide dismutase activity is then measured by the degree of inhibition of this reaction. One unit of SOD is that which causes a 50% inhibition of the rate of reduction of INT under the conditions of the assay. Briefly, 0.05 ml diluted sample in a test tube was added 1.7 ml mixed substrate solution and mixed. Xanthine oxidase (0.25ml) was added and the initial absorbance taken after 30s. The final absorbance was taken after 3mins and units of SOD per gram haemoglobin was extrapolated from a standard curve.

### 2.2.3.9 Assay for Glutathione peroxidase (GP<sub>x</sub>) activity

The assay for Glutathione Peroxidase (GP<sub>x</sub>) was done according to the method of [14]. Glutathione peroxidase (GP<sub>x</sub>) catalyses the oxidation of glutathione (GSH) by cumene hydroperoxidase. In the presence of glutathione reductase (GR) and NADPH the oxidised glutathione (GSSG) is immediately converted to the reduced form with a concomitant oxidation of NADPH and NADP<sup>+</sup>. The decrease in absorbance at 340nm was measured.

**Table 1. Effects of palm wine administrations on liver function parameters of albino rats**

Group	AST (IU/l)	ALT (IU/l)	ALP (IU/l)	T.BIL (IU/l)	D.BIL (IU/l)
Group1	10.505±0.121 <sup>a</sup>	8.140±0.0462 <sup>c</sup>	8.250±0.577 <sup>e</sup>	0.650±0.012 <sup>g</sup>	0.160±0.012 <sup>i</sup>
Group2	10.700±0.346 <sup>a</sup>	7.950±0.104 <sup>c</sup>	8.300±0.231 <sup>e</sup>	0.700±0.006 <sup>g</sup>	0.135±0.006 <sup>i</sup>
Group3	9.615±0.225 <sup>b</sup>	7.980±0.023 <sup>c</sup>	7.395±0.710 <sup>f</sup>	0.120±0.041 <sup>h</sup>	0.120±0.041 <sup>i</sup>
Group4	9.860±0.162 <sup>b</sup>	8.110±0.104 <sup>c</sup>	7.990±0.127 <sup>e</sup>	0.145±0.064 <sup>g</sup>	0.145±0.064 <sup>i</sup>
Group5	9.390±0.624 <sup>b</sup>	7.415±0.548 <sup>d</sup>	8.000±0.092 <sup>e</sup>	0.170±0.012 <sup>h</sup>	0.170±0.012 <sup>i</sup>

Results are expressed as mean ± standard deviations (n=4). Mean values with different letters as superscripts down the columns are considered significant at P<0.05.

Group 1: normal control, not administered palm wine

Group 2: administered 15ml/kg of fresh palm wine.

Group 3: administered 30ml/kg of fresh palm wine.

Group 4: administered 15ml/kg of prolonged fermented palm wine.

Group 5: administered 30ml/kg of prolonged fermented palm wine.

**Table 2. Effects of palm wine administrations on antioxidants parameters**

Group	MDA (mg/dl)	GSH (mg/dl)	SOD (U/l)	GP <sub>x</sub> (U/l)
Group 1	1.045±0.052 <sup>c</sup>	6.140±0.069 <sup>a</sup>	2.990±0.012 <sup>e</sup>	3.110±0.035 <sup>g</sup>
Group 2	0.630±0.162 <sup>d</sup>	6.055±0.098 <sup>a</sup>	2.735±0.110 <sup>f</sup>	2.920±0.046 <sup>g</sup>
Group 3	0.445±0.283 <sup>d</sup>	6.090±0.104 <sup>a</sup>	2.975±0.040 <sup>e</sup>	3.080±0.023 <sup>g</sup>
Group 4	0.820±0.439 <sup>c</sup>	5.950±0.058 <sup>b</sup>	2.915±0.098 <sup>e</sup>	2.700±0.046 <sup>h</sup>
Group 5	0.439±0.081 <sup>c</sup>	5.925±0.064 <sup>b</sup>	2.870±0.115 <sup>e</sup>	2.710±0.346 <sup>h</sup>

Results are expressed as mean± standard deviations (n=4). Mean values with different letters as superscripts down the columns are considered significant at P<0.05.

Group 1: normal control, not administered palm wine

Group 2: administered 15ml/kg of fresh palm wine.

Group 3: administered 30ml/kg of fresh palm wine.

Group 4: administered 15ml/kg of prolonged fermented palm wine.

Group 5: administered 30ml/kg of prolonged fermented palm wine.

**Table 3. Effect of palm wine administration on body weights of albino rats**

Group	Body weights per week (in grams)		
	Week 1	Week 2	Week 3
Group 1	278.543±23.679 <sup>a</sup>	407.375±49.872 <sup>c</sup>	296.020±89.633 <sup>h</sup>
Group 2	187.125±23.181 <sup>b</sup>	259.545±23.115 <sup>d</sup>	180.035±34.316 <sup>i</sup>
Group 3	218.982±8.535 <sup>ab</sup>	334.225±21.205 <sup>e</sup>	247.673±19.987 <sup>j</sup>
Group 4	214.600±28.121 <sup>b</sup>	365.737±40.790 <sup>f</sup>	280.680±45.394 <sup>k</sup>
Group 5	222.843±72.878 <sup>ab</sup>	286.003±20.277 <sup>g</sup>	207.578±30.395 <sup>l</sup>

Results are expressed as mean± standard deviations (n = 4). Mean values with different letters as superscripts down the columns are considered significant at P < 0.05.

Group 1: normal control, not administered palm wine

Group 2: Administered 15ml/kg of fresh palm wine.

Group 3: Administered 30ml/kg of fresh palm wine.

Group 4: Administered 15ml/kg of prolonged fermented palm wine.

Group 5: Administered 30ml/kg of prolonged fermented palm wine.

However, in group 2, it was observed to increase but the increase was not significant (P>0.05) when compared to the control group (group 1). For Alanine Aminotransferase activity, it was observed to decrease in group 5 significantly (P<0.05) when compared to control group. But in groups 2, 3 and 4 respectively, it was observed to decreased but the decrease was not

significant (P>0.05) when compared to the control group. The activity of alkaline phosphate was observed to decrease significantly (P<0.05) in group 3 when compared to the control group 1. However, the decrease in the activities of ALP in groups 4 and 5, were not significant (P>0.05) when compared to control group. In group 2, there was a non-

significant ( $P>0.05$ ) increase in the activities of ALP.

For total bilirubin concentration, there was a significant ( $P<0.05$ ) decrease in its concentration in groups 3 and 5, when compared to the control group. Its concentration also decreased in group 4, but the decrease was not significant ( $P>0.05$ ) when compared to the control group. However, in group 2, T. Bil concentration was observed to increased non-significantly ( $P>0.05$ ) when compared to the control group.

For Direct Bilirubin concentration, in groups 2, 3 and 4 respectively, it was observed to decrease but it was not significant ( $P>0.05$ ) when compared to the control group. However, in group 5, it was observed to increase but the increase was not significant ( $P>0.05$ ) when compared to the control group.

### **3.1.2 Effects of palm wine administrations on pro- and antioxidant parameters of albino rats**

As shown in the Table 2, Malondialdehyde concentration was observed to decrease significantly ( $P< 0.05$ ) in groups 4 and 5 when compared to the control group ( group 1 ). However, in groups 2 and 3 it was observed to decrease but the decrease was not significant ( $P> 0.05$ ) when compared to the control group. Superoxide Dismutase activities, were observed to decreased significantly ( $P< 0.05$ ) in groups 2 and 3 when compared to the control group. It was however observed to decrease non-significantly ( $P>0.05$ ) in groups 4 and 5 when compared to control group. Group 2 showed a significant ( $P< 0.05$ ) decrease in glutathione peroxidase ( $GP_x$ ) when compared to control group. Whereas a non- significant decrease was observed in groups 3, 4 and 5 when compared to the control group. The concentration of glutathione (GSH) were significantly ( $P< 0.05$ ) lower in groups 4 and 5 when compared to the control group, but its concentrations decrease in groups 2 and 3 were non- significantly ( $P>0.05$ ) when compared to the control group.

### **3.1.3 Effects of palm wine administrations on body weights of albino rats**

The mean body weights of albino rats taken on weekly basis for three consecutive weeks following palm wine administration are as shown in Table 3. The results showed that the mean

body weights of the rats in all the groups, including control the group (group 1) increased remarkably from week 1 to week 2 and were observed to decrease in week 3. The rats in groups 2 and 5 showed the highest level of decreased body weights by week 3. The weekly comparison showed that on week 1, group 2 and 4 decreased significantly ( $P<0.05$ ) when compared to the control while the decrease in groups 3 and 5 were not statistically significant ( $P>0.05$ ). By the second week, the mean body weights in all the test groups except group 4 decreased significantly ( $P<0.05$ ) when compared to the control, and by the third week, the mean body weights of the rats showed significant ( $P<0.05$ ) decrease in groups 2 and 5 while the decrease in groups 3 and 4 were not statistically significant.

## **3.2 Discussion**

This study investigated the effects of palm wine administration on some biochemical parameters and body weight in albino rats. The observed significant decrease in the activities of liver enzymes such as AST, ALT, and ALP may be attributed to its antioxidant activity. There exist evidence that palm wine contain ascorbic acid (vitamin C) [15], and being an antioxidant, has also been found to have a scavenging effects on reactive oxygen species (ROS) free radicals produce by alcohol dehydrogenase pathway [16]. It has also been demonstrated by previous studies that vitamin C has a synergistic antioxidant action [17]. Vitamin C is known to be an important free radicals scavenger in extracellular fluids by donating electrons and neutralizing free radicals thereby protecting biomembranes from the destructive effects of peroxides. The observed significant decrease in those enzymes activities in the present work could be that the ascorbic acid present in palm wine administered at 15ml/kg and 30ml/kg respectively for both fresh palm wine and prolonged fermented palm wine may have protected the liver by suppressing the activities of reactive oxygen species which would have caused inflammation to the liver cells thus increasing the activities of liver enzymes in the blood. The reduced activities of the enzymes may also be related to the dose administered as only high doses of alcohol may induce liver cirrhoses in healthy subjects.

Bilirubin concentration was also observed to be significantly low in the experimental groups. Ascorbic acid has been shown to interfere with

bilirubin formation according to [18]. The observation recorded in this study could be that palm wine administered at 15ml/kg and 30ml/kg respectively may have increased the level of ascorbic acid in the serum thereby inhibiting total bilirubin concentration in the serum. According to [19], vitamin C has been found to falsely decrease bilirubin level. So, the observation in this present work could be that the ascorbic acid present in the palm wine administered at 15ml/kg and 30ml/kg respectively may have inhibited the bilirubin level leading to its significant decrease. Malondialdehyde concentration was observed to decrease significantly ( $P < 0.05$ ) in groups 4 and 5 that were administered the prolonged-fermented palm-wine. Since MDA is a product of lipid peroxidation, the decrease observed in this present study could be due the presence of vitamin C which have an antioxidant activities and is capable of reducing oxidizing substances such as hydrogen peroxide [20].

The concentration of glutathione (GSH) were significantly ( $P < 0.05$ ) lower in the groups administered the prolonged-fermented palm-wine. The significant decrease in GSH after could be indicative of impaired reduction of oxidized glutathione to reduced form [21].

The activities of Superoxide dismutase were observed to decrease significantly ( $P < 0.05$ ) in groups 2 and 3 when compared to the control group. It was however observed to decrease in the groups administered fresh palm-wine. This decrease could predispose cellular macromolecules to oxidative rout of superoxide ion, hydroxyl radical, and hydrogen peroxide [22]. Glutathione peroxidase ( $GP_x$ ) was observed to decrease due to palm-wine administration. This could be due to either free radical dependent inactivation of enzyme or depletion of its co-substrates i.e. GSH or NADPH in ethanol treated rats [23].

The rats were observed to remarkably increase in body weights (including control group) from week 1 to week 2. The weekly mean body weights were uniform throughout the period of study for the control group, but declined in week 3 as the rats advanced in age. It is believed that chronic alcohol consumption causes the release of cytokines and chemokines which permeate the blood-brain barrier to stimulate the vegetative areas of the brain causing an increase in hunger which leads to the increased food and water intake [24]. This then causes decreased catabolism but increased anabolism, thus

resulting in increased pepsinogen production [25]. This may also, result to an increased production of other tissue proteins leading to tissue growth [26], which may cause increased body weights as observed in the first two weeks among the test groups. The decline in body weight observed in the test group by the third week could have resulted from advancement in age, or presence of yeast in the palm sap and the low content of ethanol in the palm-wine or both.

The decrease in body weights of rats observed in group 2 and 4 when compared to the control in the first week might either be due to the rats not been fully adaptive to the laboratory environments at initial stage. On the other hand, by the second week, palm wine (administered to the test groups) may pose appetite-suppressant effects and this effects produces weight loss in the test groups [24]. According to [27] body weight of rats administered with ethanol usually decrease. Since some of the sugar content in the palm-wine were subsequently metabolized to alcohol in the rats' body by *Saccharomyces cerevisiae* present in the palm sap [28].

#### 4. CONCLUSION

This research evaluated the effect of palm-wine on some biochemical parameters in albino rat models and the results depict that fresh and prolonged fermented palm wine administration to rats at 15ml and 30ml/kg for 28 days did not exert remarkable toxic effect on the liver biomarkers and may not have induced oxidative stress as manifested by the analyzed biomarkers but significantly reduced body weights of the rats in the third week of administration.

#### ETHICAL APPROVAL

Animal Ethic committee approval has been collected and preserved by the author(s)

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## COMPETING INTERESTS

Authors have declared that no competing interests exist.

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