

Research Article

## Evolution of Serum Parameters in Rats Fed with *Bombax Buonopozense* Based Diets

Jean Bonaventure Kouadio Koffi<sup>1</sup>, Yolande Dogoré Digbeu<sup>1, \*</sup>,  
Armelle Moya Felarry Hoba<sup>2</sup>, Edmond Ahipo Du é<sup>2</sup>, Kouakou Brou<sup>1</sup>

<sup>1</sup>Laboratory of Food Safety, Nangui Abrogoua University, Abidjan, Côte d'Ivoire

<sup>2</sup>Biochemistry and Food Technology Laboratory, Nangui Abrogoua University, Abidjan, Côte d'Ivoire

### Abstract

The present study sought to undertake the nutritional importance of *Bombax buonopozense calyces* through the determination of serum parameters in rats fed with diets based on fresh and dried calyx of *Bombax buonopozense* (false kapok). Furthermore, Six (6) batches of 36 rats (males and females) of the species *Rattus norvegicus* were constituted, each receiving a diet. After analysis, serum parameters such as the PAL biomarker are widely present in rats regardless of the diet consumed (approximately 291.12 IU/L) and statistically identical for rats subjected to the DMT, DFT and FMT diets as well as their congeners fed the control diets FC and MC. However, at the level of the PAL marker, only the FMT batch differs from the others, which are lower than the controls; followed by the TGO marker with a significant content in rats fed the FFT, DFT and FMT diets (approximately 297 IU/L) which are statistically identical. Then come those of rats fed the MC, DMT and FC diets. Next comes the TGP marker with a significant content in rats fed the FMT diet (64.92 IU/L); followed by rats fed the MC, FFT, DFT then FC and DMT diets (2 6.77 IU/L). In terms of hematological parameters, rats fed the DMT diets have statistically lower hematocrit than MC controls, on the other hand, their congeners fed the DFT and FMT diets have normal hematocrits. Also, the mean corpuscular volume (MCV) followed by the mean corpuscular hemoglobin concentration (MCHC) and the rate of corpuscular hemoglobin (CH) content is very minimal in the blood of rats regardless of diet except those force-fed with DFT diets which affect MCHC. Overall, it was the female rats fed fresh *Bombax buonopozense calyx*, which stand out with a negative impact on hematological parameters. On the other hand, their male counterparts subjected to dry and fresh *Bombax buonopozense diets* generally appear normal; which aims to promote and take into account this species at the dietary and medical level.

### Keywords

Serum Parameter, Hematological Parameter, Diet, *Bombax Buonopozense*, Calyx

## 1. Introduction

Plants have been the primary source of medicines for humans who used them as therapeutic remedies for a long time [1] but also as food. In order to address the malnutrition that is rampant in many developing countries, particularly with in-

creasing demographic pressure [2], plant resources, because of their bioavailability and their low cost compared to animal proteins can constitute an outcome in the improvement of the nutritional and health quality of populations in the third world

\*Corresponding author: [digbeuyolande@gmail.com](mailto:digbeuyolande@gmail.com) (Yolande Dogoré Digbeu)

Received: 23 June 2025; Accepted: 7 July 2025; Published: 8 August 2025



Copyright: © The Author(s), 2025. Published by Science Publishing Group. This is an **Open Access** article, distributed under the terms of the Creative Commons Attribution 4.0 License (<http://creativecommons.org/licenses/by/4.0/>), which permits unrestricted use, distribution and reproduction in any medium, provided the original work is properly cited.

[3]. Côte d'Ivoire has been in search of plants for their numerous products and services for centuries [4]. Several research studies carried out with a view to proposing the use of available local food resources. *Bombax buonopozense*, called false kapok tree or silk cotton tree, has caught our attention because of its red flowers, whose floral part is edible and used as a vegetable by the locals [5]. It is a spontaneous plant, a large tropical tree that grows up to 40 meters in height [6] with another species *Bombax costatum* from Sudanese areas that is little studied and underutilized [4]. Hematological and serum parameters are reliable means of assessing health and condition [7] of various animals, like Wistar rats of the species *Rattus norvegicus*, to demonstrate the impact of this food resource.

The objective of this study is to determine the nutritional importance of *Bombax buonopozense* calyxes through the determination of serum and hematological parameters of rats force-fed with different diets of fresh and dried calyx of *Bombax buonopozense*.

## 2. Material and Methodologies

### 2.1. Material

#### 2.1.1. Animal Material

The animal material used for this study consisted of 36 male and female rats of the Wistar strain of the species *Rattus norvegicus*, aged 6 to 8 weeks, with weights between 58.2-90.2 g  $\pm$  7.07 g, from the vivarium of the animal physiology laboratory of the NANGUI Abrogoua University (Abidjan, Ivory Coast). The females were nulliparous and non-pregnant. The animals were kept in a stabilization period for two weeks before the experiment in order to regulate and harmonize their physiological states before the experiments. They were marked to allow individual identification, installed in transparent plastic cages equipped with a label holder where the name of the batch and the food administered is mentioned. In this animal house, the average temperature was  $26 \pm 4$  °C with a relative humidity of 60% and a photoperiod of 12/24. At the start of the experiment, the animals were fed a standard experimental animal diet and received water ad libitum. The bedding used is sawdust renewed twice a week to ensure the good hygienic condition of the animals.

#### 2.1.2. Technical Equipment and Reagents for Toxicological Testing

The technical equipment used in the study consisted of Precision electrical balance (Sartorius); Gavage probe (Drencher); Cage; Distilled water; Beaker; Ether; Collecting tubes containing EDTA (Dmi) and dry tubes (Dmi); Marker. As for the reagents, they consisted of ether.

### 2.2. Methods

#### 2.2.1. Constitution of Lots

The lots consisted of

-1 Lot (1) MC: (Male Control): for male animals fed with commercial feed

-1 Lot (2) FC (Female Control): for female animals fed with commercial feed

-1 Lot (3) DMT (Dry male Trial) for male animals fed with dried calyxes

-1 Lot (4) DFT (Dry Female Trial): for female animals fed on dried calyx

-1 Lot (5) FMT (Fresh Male Trial): male animals fed on fresh calyxes

-1 Lot (6) FFT (Female Fresh Trial): for female animals fed on fresh calyxes

Each batch consisted of six (6) subjects.

#### 2.2.2. Preparation of Samples

##### Subacute toxicity

For the preparation of dry and fresh calyx samples, 5 g of dried calyx powder of *Bombax b.* and fresh calyx ground material were separately boiled in 100 ml of distilled water for 5 minutes and then cooled. The study was conducted according to OECD Guideline 407 [8]. It was carried out on 36 Wistars albino rats divided into six equal groups of 3 males and 3 non-pregnant nulliparous females. The control group received distilled water at a rate of 1 mL/100 mg of body weight. The animals received 1 ml/100 g of feed daily by intragastric gavage (oral route) for 28 days. The rats were fed and hydrated ad libitum and weighed every 5 days. At the end of the experiment, the rats were fasted for 24 h, then blood was sampled for hematological and biochemical analyses followed by dissection after administration of Ketamine, at a dose of 50 mg/Kg. The organs sampled were the liver, kidneys, spleen, lungs and heart. These were rinsed with 0.9% saline and then weighed.

#### 2.2.3. Blood Sampling

Blood samples are taken from rats fasting and under diethyl ether anesthesia. They are taken on the day of euthanasia from the cavernous sinus using microhematocrit tubes. During each sample, 2 to 3 ml of blood are collected in a heparinized tube and in another tube containing EDTA, then the heparinized tubes are centrifuged at 4000 g/5min. at 4 °C. The serum obtained is aliquoted and stored at a temperature of -20 °C until biochemical analyses.

At the end of the 28 days of experimentation, the blood samples collected in dry tubes were used to measure serum levels of urea, creatinine, transaminases (AST, ALT), and those collected in heparinized tubes were used to measure the levels of white blood cells, red blood cells, hemoglobin, hematocrit and blood platelets.

## 2.2.4. Principles of Dosage of Serum Metabolites and Electrolytes

Serum metabolite assays (glucose, triglycerides, total protein, total cholesterol, HDL-cholesterol, LDL-cholesterol, urea, creatinine, uric acid, total bilirubin, conjugated bilirubin, alkaline phosphatase (ALP), aspartate aminotransferase (AST), alanine aminotransferase (ALT), phosphorus, calcium, magnesium, iron, sodium, and potassium) were performed on serum samples using a HITACHI 902 autoanalyzer - Roche, Japan. The autoanalyzer uses standard blood parameters assay techniques.

### Serum enzyme level

**Alkaline phosphatase levels:** Alkaline phosphatase determination was performed by the colorimetric method described by Bakker et al. [9].

**Aspartate aminotransferase levels:** Determination of aspartate aminotransferase (ASAT) or serum glutamate-oxaloacetate transaminase (SGOT) or TGO (Glutamyl oxaloacetate-transferase) was carried out by the colorimetric method described by Henry [10].

**Alanine aminotransferase levels:** The determination of alanine aminotransferase (ALAT), also called serum glutamate-pyruvate transaminase (SGPT) or TGP (Glutamyl-pyruvate transaminase), was carried out using the colorimetric method described by Henry [10].

**Gamma glutamyltransferase levels:** Determination of gamma glutamyltransferase (GGT) was performed by the colorimetric method described by Szasz [11].

## 2.2.5. Statistical Analyses

All measurements were performed in triplicate. Statistical analyses of the data were performed using Statistica software version 7.1. In addition, the Chi-square significance test was used to monitor the evidence of relationships between categorical variables. Two-way analysis of variance (ANOVA) was used to demonstrate the effect of factors on the studied parameters. Duncan's test and Student's t-test were used to perform multiple comparisons. Statistical significance was defined as  $p \leq 0.05$ .

## 3. Results

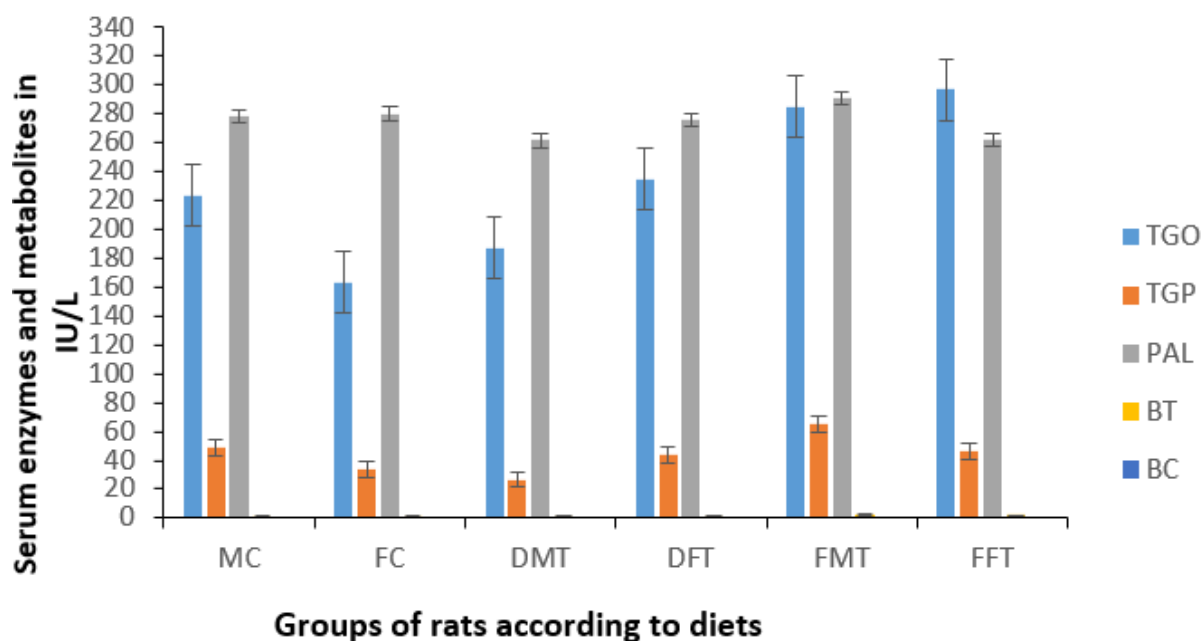


Figure 1. Evolution of rat liver biomarkers.

MC: male control; FC: female control; DMT: dry male test; DFT: dry female test; FMT: male fresh test; FFT: female fresh test BT: total bilirubin, BC: conjugated bilirubin; ALP: alkaline phosphatase aspartate aminotransferase; TGP or (ALAT) Alanine aminotransferase; TGO or ASAT: aspartate aminotransferase

## 3.1. Serum Parameters

According to Figure 1, the PAL biomarker is widespread in rats regardless of the food they consume (approximately 291.12 IU/L) and is statistically identical to those who were

fed with DMT, DFT, FMT diets, and control diets (FC, MC). Rats fed with FFT, DFT, and FMT diets have a TGO marker with a significant content (approximately 297 IU/L) that is statistically identical; then come those of rats fed with MC, DMT and FC diets. Rats eating the FMT diet had a significant

amount of the TGP marker (64.92 IU/L), while those eating the FFT, DFT, FC, and DMT diets had 26.77 IU/L. Furthermore, the BC biomarker for all animals with minimum values is not significantly different ( $p > 0.05$ ). The BT marker is then utilized, and only the rats that are tested for FMT and FFT are statistically identical and superior to other tests with no significant difference ( $p > 0.05$ ).

### 3.2. Parameters Hematological

The values of hemoglobin (HGB), white blood cells

(WBC), red blood cells (RBC), which range from 4.73 -12.87 g/L, and lymphocytes (LYM) are depicted in Figure 2A. Afterwards, there are granulocytes (GRAN) and monocytes (MONO), which are extremely small (0.3-2.06) g/L. As per Figure 2B, the mean corpuscular volume (MCV) was recorded at 61.20-65.33 IU/L, and the mean corpuscular hemoglobin concentration (MCHC) was found to be 27.97-87.24 IU/L, with rats assigned to the DFT diet having a higher rate (87.22-44.44 g/L) than the control. No matter what diet the rats eat, the levels of (MCH) corpuscular hemoglobin content (17.90-20.03 IU/L) are minimal.

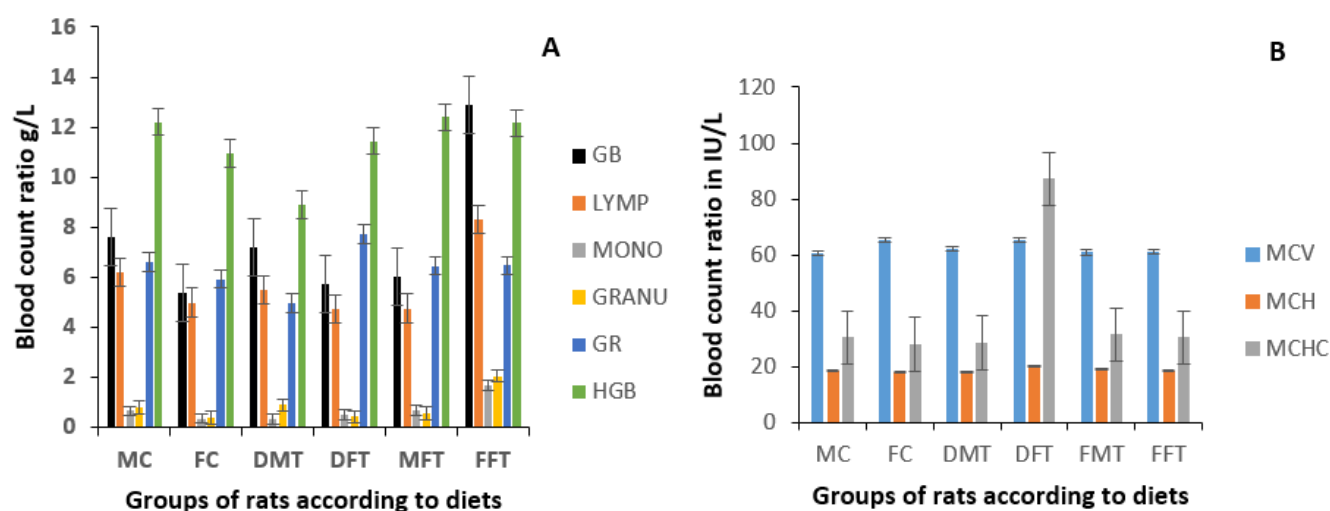


Figure 2. A, B: Effects of bombax consumption on hematological parameters.

MC: Male Control; FC: Female Control; DMT: Dry Male test; DFT: Dry Female Test; FMT: Male Fresh Test; FFT: Female Fresh Test; GB: White Blood Cell; LYMP: Lymphocyte; MONO: Monocyte; GRAN: Granulocyte; RBC: Red Blood Cell; HGB: Hemoglobin; MCV: Mean Corpuscular Volume; MCH: Hemoglobin Content; MCHC: Corpuscular Hemoglobin Concentration

#### Hematocrit and Platelet Counts in Rats Based on Bombax Buonopozense Diets

Table 1 depicts the amounts of blood platelets and the hematocrit levels that were observed. The hematocrit (HCT) levels of rats fed with MC, FMT, and FFT diets are identical and superior to those of FC and DFT, which are identical,

followed by DMT. There is a significant difference in the platelets of congeners fed with the different control diets (MC and FC) ( $910.7 \times 10^9$  /L) which are statistically superior to the trials studied with DFT and FFT, which are identical ( $761.3 \pm 33.59 \times 10^9$  /L and  $805.3 \pm 20.45 \times 10^9$  /L respectively) followed by FMT and DMT.

Table 1. Hematocrit and platelet counts in rats based on bombax buonopozense diets.

|                | MC                             | FC                             | DMT                         | DFT                            | FMT                            | FFT                            | P value |
|----------------|--------------------------------|--------------------------------|-----------------------------|--------------------------------|--------------------------------|--------------------------------|---------|
| HCT (%)        | 40.10 $\pm$ 0.03 <sup>a</sup>  | 38.67 $\pm$ 0.02 <sup>b</sup>  | 30.90 $\pm$ 00 <sup>a</sup> | 37.53 $\pm$ 0.94 <sup>a</sup>  | 39.43 $\pm$ 1.21 <sup>a</sup>  | 39.70 $\pm$ 0.70 <sup>a</sup>  | 0.00    |
| PLT ( $10^9$ ) | 890.3 $\pm$ 36.16 <sup>a</sup> | 910.7 $\pm$ 35.42 <sup>a</sup> | 379 $\pm$ 00 <sup>b</sup>   | 761.3 $\pm$ 33.59 <sup>a</sup> | 503.3 $\pm$ 68.40 <sup>b</sup> | 805.3 $\pm$ 20.45 <sup>b</sup> | 0.0046  |

The means assigned to different letters on the same line are significantly different at the 5% threshold;

MC: Control male; FC: Control Female; DMT: Dry Male Test; DFT: Dry Female Test; FMT: Male Fresh Test; FFT: Female Fresh Test; HCT: Hematocrit; PLT: Platelet

## 4. Discussion

The PAL biomarker of the DMT, DFT, and FMT diets does not differ significantly ( $p > 0.05$ ) from the controls (about 291.12 IU/L), so it appears that this parameter is normal for these rats in all diets except for FFT. The FFT test would cause recent hepatic cytolysis [12]. Studies have demonstrated that an increase in PAL is a sign of liver injury, likely caused by impaired cellular membrane permeability, which results in the release of enzymes into the serum [13]. The TGO marker has a significant content in rats force-fed with FFT and DFT diets, which are statistically higher than the FC control; hence, these diets as well as FMT would cause dysfunction in the kidneys following regular consumption. On the other hand, only the rats of the DMT diets have their TGO lower than their MC control and higher than those of the work of Devaki et al. [13] which varies around 71 U/I for the toxicity effects of *Passiflora edulis* extracts, but which remains stable.

Then the TGP marker level for rats fed the FMT diet (64.92 IU/L) and those fed the FFT and DFT diets is higher than that for FC. This result indicates that only rats that consume DMT diets have a lower content than their counterparts.

Furthermore, these diets would have hepatoprotective effect [14, 15]. Moreover, a decline in the liver enzymes ASAT, ALAT, and PAL could indicate that the plant has a protective effect on the liver. The results obtained could be explained by the fact that these diets do not cause a degradation of the function of liver cells, which would lead to an abnormal release of enzymes [16]. In addition, the DFT, FMT, and FFT diets, which will still cause hepatic cytolysis even after regular consumption [17]. Indeed, the increase in ASAT and ALAT levels in the blood is due to their release following damage to liver cells [18, 19].

The BT marker is statistically identical in both FMT and FFT trials, but there is no significant difference ( $p > 0.05$ ) in the other trials. The regular consumption of these FMT and FFT trials would lead to a negative impact on kidneys.

There is no significant difference in the BC biomarker (0.3 g/L) which would be explained by an identical overall functioning of the livers of rats from different batches [20, 21].

The blood count (blood formula) is a test that provides information on the elements contained in the blood (red blood cells, leukocytes and blood platelets). It can reveal a large number of pathologies such as anemia, coagulation problems and viral infections. Hematological parameters are also used as early indicators of the toxicity of pollutants on these tissues [22]. Rats fed DMT diets have statistically lower hematocrit than MC controls. This is also reflected in the level of white blood cells, lymphocytes, monocytes and granulocytes but also in the level of red blood cells (hemoglobins). Various studies have indicated that the decrease in red blood cells and hemoglobin could be caused by anemia [12]. Hence, these diets would be the basis of anemia. In addition, white blood cells are protective cells of the

body against infections. Their decrease is an indicator of the failure of the immune system [1]. However, according to Saadi et al. [23], an increase in the number of WBCs is often considered as a clear sign of immune system activation, moreover it is the rats fed the FFT diet that would trigger this immune activation. On the other hand, rats fed the DFT and FMT diets statistically identical in hematocrit to those of their FC congeners therefore have normal hematocrits. Nevertheless, there is a significant difference in the platelets of animals from the different control diets MC and FC ( $910.7 \times 10^9$  /L) which are statistically higher than the trials studied DFT and FFT followed by FMT and DMT. Hence, the platelet count of these diets is decreasing; also, the (MCV) mean corpuscular volume followed by the (MCHC) mean corpuscular hemoglobin concentration and the rate of (MCH) corpuscular hemoglobin content is minimal in the blood of rats regardless of the diet administered. Therefore, consumption of these diets in general by rats does not affect these enzymes, except those of the DFT diet, which affects MCHC.

## 5. Conclusion

At the conclusion of this study, it is important to note that only the FMT batch differs from the others, which are inferior to the controls at the level of the PAL marker. Regular consumption of all diets, including FFT and DFT diets (for TGO and BT markers), and FMT (for TGO), would result in kidney dysfunction for the TGP marker. DMT diets cause rats to have a lower hematocrit compared to MC controls, but normal hematocrits are observed in rats fed DFT and FMT diets. No matter what diet is administered, the (MCV) mean corpuscular volume, (MCHC) mean corpuscular hemoglobin concentration, and (MCH) corpuscular hemoglobin content are all less in rats' blood. Therefore, these diets do not affect these enzymes, except that of the DFT diet, which affects MCHC. In general, the fresh *Bombax calyx* assays are found to have a negative effect on hematological parameters in female rats compared to the dried assays. On the other hand, those of the DMT and FMT diets (males) overall seem normal, which should be valued and taken into account at the dietary and medical level.

## Abbreviations

|     |                                                 |
|-----|-------------------------------------------------|
| ALP | Alkaline Phosphatase Aspartate Aminotransferase |
| BC  | Conjugated Bilirubin                            |
| BT  | Total Bilirubin                                 |
| DFT | Dry Female Test                                 |
| DMT | Dry Male Test                                   |
| FC  | Female Control                                  |
| FFT | Female Fresh Test                               |
| FMT | Male Fresh Test                                 |
| HCT | Hematocrit                                      |
| MC  | Male Control                                    |

|               |                           |
|---------------|---------------------------|
| PLT           | Platelet                  |
| TGO or ASAT   | Asparate Aminotransferase |
| TGP or (ALAT) | Alanine Aminotransferase  |
| UI            | International Unit        |
| TGP or (ALAT) | Alanine Aminotransferase  |

## Author Contributions

**Jean Bonaventure Kouadio Koffi:** Investigation, writing original draft

**Yolande Dogor é Digbeu:** Conceptualization, Methodology, writing original draft, Visualization, writing- review & editing

**Armelle Moya Felarry Hoba:** Conceptualization, Data retention, Formal analysis, writing original draft

**Edmond Ahipo Du é** Project Supervision, Conceptualization, Validation resources

**Kouakou Brou:** Conceptualization, Project Supervision and Administration

## Funding

No external funding supported this work.

## Conflicts of Interest

The authors declare no conflicts of interest.

## References

- [1] Gbogbo M., Koné M., Oussou N'G. J.-B., Kporou K. E., Kouadio K. H. U. & Yapo A. P. (2022). Acute toxicity study of an ethanolic extract of *Massularia acuminata* (Rubiaceae) stem in Wistar rat. *International Journal of Innovation and Applied Studies*, ISSN 2028-9324, 35(2): 260-2672.
- [2] Hoba F. M. A. (2019). Nutritional characteristics of the Ackee (*Blighia sapida* K. Koeinig, 1782) and use of their cakes in the production of Japanese quail (*Coturnix japonica* Temminck and Schlegel, 1849) in Côte d'Ivoire. Doctoral thesis Biochemistry and Food Processing Technology, Nangui Abrogoua University, Abidjan, Côte d'Ivoire, 489, 1-167 p.
- [3] Mât é A., Gustave Koffi Kouam é S éraphin Kati-Coulibaly & Michel Att éOffoumou. (2008a). Study of the nutritional value of regular bread and composite breads containing de-lipid seed flour from *Citrullus lanatus* (Cucurbitaceae). *Bulletin of the Royal Society of Sciences of Li ège*, 77, pp. 80-103.
- [4] Kouakou Y. B., Kougbo M. D. & Konan A. S. (2020). Traditional uses and availability of plants used in crafts among the Koulango and Lobi populations of the eastern periphery of the Comoé National Park, Côte d'Ivoire. *European Scientific Journal*, 16(9): 295-320.
- [5] Abdullahi M., Buhari S. F. & Abdulrauf M. (2011). Antimicrobial activity of *Bombax buonopozense* P. Beauv. (Bombacaceae) edible floral extracts. *Revue européenne de recherche scientifique*, 48(4): 627-630.
- [6] Aquador G. C., Muazzam I., Usman Idris M., Megwas U. A., Akpan J. L., Chilaka K. C., DO Okoroafor D. O. & Osunkwo U. A. (2011). Evaluation of the antidiarrheal activity of the methanolic extract of *Bombax Buonopozense* leaves in rats. *Revue Ibmossina dede médecine et de sciences biomédicales*, 3(1): 15-20.
- [7] Atchade G. S. T., Mensah S. E. P., Houndonougbo M. F. & S éidji Eug ène Attakpa S. E. (2019). Serum biochemical parameters of rabbits (*Oryctolagus cuniculus* linnaeus, 1758) fed with diets based on West African food resources: Bibliographic synthesis. *Journal of Applied Biosciences*, 138: 14060-14071.
- [8] OECD. (2008). Acute oral toxicity: Up and down procedure, Guideline for the Testing of Chemicals 425 OECD; 1-2.
- [9] Bakker A., M ècke M., (2007). Gammopathy interference in clinical chemistry assays: mechanisms detection and prevention. *Clin Chem Lab Med*. 45(9) 1240-1243.
- [10] Henry R. J., 1974. Clinical chemistry principles and techniques. Second Edition, Harper and Row, p. 543.
- [11] Szasz G. (1969). *Clin chem* 22 p 124-136.
- [12] Aguemon M. T. (2023). Nutritional potential of mature seeds of the fig tree (*Blighia sapida*) and impact of glycine and riboflavin on its toxicity in the diet of Cobb 500 broiler chickens; Doctoral thesis in Biochemistry and Food Technology, NANGUI Abrogoua University, Abidjan, Côte d'Ivoire, 882, 1-181 p.
- [13] Devaki K., Beulah U., Akila G., & Gopalakrishnan (2012). Effect of aqueous extract of *Passiflora edulis* on biochemical and hematological parameters of albino rats. *Toxicology International*, 19(1): 63-67.
- [14] Da Silva, A. R. H., Reginato, F. Z., Guex, C. G., Figueredo, K. C., Araldi, I. C. D. C., De Freitas, R. B., Boligon, A. A., Athayde, M. L., Melazzo De Andrade Mazzanti, C., Hübscher, G. H. & Bauermann, L. D. F. (2015). Acute and sub-chronic (28 days) oral toxicity evaluation of tincture *Baccharis trimera* (Less) Backer in male and female rodent animals. *Regulatory Toxicology and Pharmacology*, 74: 170-177.
- [15] Adewale O. B., Onasanya A., Anadozie S. O., Abu, M. F., Akintan I. A., Ogbole C. J., Olayide I. I., Afolabi O. B., Jaiyesimi K. F., Ajiboye B. O. & Fadaka A. O. (2016). Evaluation of acute and subacute toxicity of aqueous extract of *Crassocephalum rubens* leaves in rats. *Journal of Ethnopharmacology*. 188: 153-158.
- [16] Doh N. A., Tchaou M. N., Vuti K., Houndji S. V., Amenyanran K., Dossou R. B. & Lamboni C. (2019). *Afraegle paniculata* oil (Schumacher and Thonn, 1915): biotolerance and biochemical impacts in rats. *Africa Science* 15(6): 384-393.
- [17] Da Silva P. F. (2009). A New Phosphate-Regulating Hormone. Study in Chronic Renal Failure. Doctorate, Diderot University, Paris, France, 1-73 p.

- [18] Ahmada M., Lima C. P., Akowvuah G. A., Ismaila N. N. Hashima M. A., Hora S. Y., Anga L. F. & Yama M. F. (2013). Safety assessment of standardized methanol extract of *Cinnamomum burmanni*. *Phytomedicine*, 20: 1124-1130.
- [19] A ĩsatou, D. S., Ngatchic M. J. T., Dongmo S. C. & Nijintang Y. (2017). Anthihyperlipidemic and hypolipidimic properties of *Tacca leontopetaloides* (L.) Kuntze (Discoreales: Discoreaceae) tuber's aqueous extracts in the rats. *Brazilian Journal of Biological Sciences*, 4(7): 67-80.
- [20] Neuberger J. (1997). Primary biliary cirrhosis. *Lancet* 350, 875-879.
- [21] Ouattara H., Kouao A. A., Alassane M. & Coulibaly S. K. (2014).). Comparison of the biotolerance of oil extracted from the aril of *Blighia sapida* (K. Koenig), compared to those of palm and olive oils in rats. *Africa Science: International Journal of Science and Technology*, 10: 226-235.
- [22] Vinodini N. A., Pratik K. C., Poulomi C., Shrijeet C., Nayanatara A. K., Ramesh M. B., Rashmi K. S., Suman V. B., Sneha B. S. & Sheila R. P. (2015). Protective Role of Aqueous Leaf Extract of *Moringa oleifera* on Blood Parameters in Cadmium Exposed Adult Wistar Albino Rats. *International Journal of Current Research and Academic Review*, 3(1): 192-199.
- [23] Saadi L., Arkam F. & Lebaili N. (2019). Effect of imidacloprid intoxication on the lungs of female Wistar rats, *Journal of Advanced Research in Science and Technology*, 6(2), 995-1004.