IAA Journal of Applied Sciences 11(2):50-59, 2024.
©IAAJOURNALS
https://doi.org/10.59298/IAAJAS/2024/112.50.59
www.iaajournals.org
ISSN: 2636-7246
IAAJAS: 112.50.59

Evaluation of Subchronic toxicity and phytochemical analysis of aqueous extract of *Ocimum suave* (Lamiciae)

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ABSTRACT

Evaluation of phytochemical content, acute and sub-chronic toxicity of the aqueous leaf extract of *Ocimum suave* in Wistar rats was carried out. Experimental rats were administered extracts daily for 31 days at dose levels of 200, 400 and 800 mg/kg. Acute toxicity and phytochemical screening of aqueous leaf extract were done according to method of Lorke's Trease and Evans. Biochemical analysis was equally done at the end of the administration of extracts using standard methods. At the end of the study, animals were sacrificed and blood samples taken for biochemical assay. The LD50 was found to be greater than 10,000 mg/kg body weight. Results showed the presence of most phytochemicals tested for. The aqueous extract caused a decrease in ALT activity but AST and CK activities were higher in the treated groups in a dose dependent manner relative to the control. The aqueous leaf extract of *Ocimum suave* affected mean cell volume, mean cell hemoglobin and mean cell hemoglobin concentration. The aqueous leaf extract caused mean body weight gain, but decrease in relative organ weight. The study suggests that the aqueous extract administered at normal therapeutic doses is not likely to produce severe toxic effects on some hematological and biochemical indices in rats and the organs tested. Chronic toxicity of aqueous leaf extract of *Ocimum suave* should be done for histological, haematological and biochemical evaluation.

Key Words: Ocimum suave, Toxicity, Wistar Rats, Biochemical assay, Phytochemical, Extract

INTRODUCTION

Majority of the world's population in developing countries rely on plant medicine for their healthcare needs either due to unavailability of or lack of trust in orthodox medicine among the local people [1,2]. Natural plant herbs have played and continues to play very important role in medicine and healthcare. Plants and natural products have been shown to possess numerous health beneficial and medicinal properties [3] They have been shown to be able to ameloriate several health conditions such as malaria, ulcer, diabetes, diarrhea, fever, athritis, epilepsy, worm infestation among others [4] They are also known to be effective in managing immuno neurodegenerative conditions, cancer and pathologic inflammatory conditions. These properties have been attributed to abundance of phytochemicals possessed by these plants. Health efficacy is equally attributed to vitamins and minerals content.

Ocimum suave is used *as* a traditional medicine for the treatment of stomach ache, cough and influenza. It is also used as a perfume, an insect repellent (particularly against mosquitoes) and a grain protectant [5]. Another species *Ocimum kilimandscharicum* Baker ex Gurke Traditonally is used for the treatment of serious colds and coughs, abdominal pains, measles and mild diarrhoea in children. It is also used as a grain protectant in East Africa. *Occimum canum* Sims leaves are used as a traditional medicine in West Africa for the treatment of fevers, dysentery and to relieve toothache the *Ocimum sanctum* alcoholic leaf extract shows significant hepatoprotective activity and synergism with silymarin [6].

Despite huge medicinal benefits, some plant decoctions are known to have serious toxic side effects. This is due to the fact that they exist in crude impure form usually in combination with several unwanted components. [7]. There is ongoing need to scientifically evaluate these plants and screen them for any side toxicity [8] This plant is particularly being used widely by the local populace without knowledge of its proper

dose and toxicity. This lack of knowledge may be causing huge problems among the people without any prior note. Therefore, there is need to evaluate possible toxic profile of this plant [9,10]. The purpose of the study was to ascertain the acute toxicity, possible biochemical and hematological effects of aqueous extract of the leaves of *Occimum suave* and further identify the compounds responsible for the effects. Unfortunately, the required information on the local species of this plant is greatly unavailable; also administration and dosage of these drugs have not been established. Therefore, in order to fill this gap in knowledge, preliminary studies have to be done to evaluate and ascertain possible risks such as undesirable effects, overdose or poisoning so that may be associated with administration and usage of the plant extract using rats as experimental model.

METHODS

Plant material identification

The *ocimum suave* plant was taxonomically identified by a botanist from Kampala International
University-Western Campus and a voucher specimen prepared and deposited in the herbarium of the School ofPharmacy.

Extract preparation

The leaves of *Ocimum suave* plant were collected and dried under shade, then ground into
powder. Extraction was by boiling in water (decoction) and this is how it was used traditionally. The extract was filtered then the filtrate evaporated and dried in water bath.

Phytochemical Screening

Secondary metabolites screening were carried out according to standard procedures as described by Sofowara [11], Trease and Evans [12]

Laboratory animal acquisition and maintenance

Male Wistar rats (weighing not less than 100g) were used for this study. The animals were bred and housed in the Animal Facility Centre of the School of Pharmacy, Kampala International University-Western Campus. The animals were then kept in a cage lined with sawdust, at room temperature with adequate ventilation, under a naturally illuminated environment with 12 hours of light/dark cycle. They were fed with standard diet (Nuvita (R) Animal Feed Ltd, Jinja Uganda) and had access to clean drinking water ad libitum. The animal experiment was conducted according to the National Institute of Health Guide for the care and use of laboratory animals and ethical guidelines for investigation of experimental pain in conscious animals [13]

Toxicity Evaluation (Acute toxicity)

This involved observation for signs of acute toxicity and other effects of the extract following administration. Acute toxicity referred to the effects on the whole body of a single dose of a chemical (or several doses within a 24- hour period), which was manifested over a period of 14 days. Determination of acute oral toxicity was an initial screening step in the assessment and evaluation of the toxic characteristics of all compounds. Acute toxicity data were used to provide a rough guide for dose selection among many other factors. The LD_{50} test was used to determine the therapeutic index, i.e. ratio between the lethal dose and the pharmacologically effective dose in the same strain and species ($LDso/ED_{50}$). The greater the index, the safer the compound was. LD_{50} with confidence limits was to be established on one common laboratory species such as mice using the Lorke' s method.

Biochemical assay

Serum and liver alanine aminotransferase (ALT) and aspartate aminotransferase (AST) were assayed by the method described by Reitman and Frankel [14]. Gamma glutamyl transpeptidase (GGT) [15] LDH and CK were analyzed using standard methods [16]

Hematological studies

Blood samples were collected into heparinized tubes and used for the estimation of Complete Blood Count using an automated cyflow machine.

All data generated was presented as Mean ± Standard Error of the Mean (SEM) and statistical comparisons were performed using descriptive statistics and ANOVA-repeated measures $p<0.05$ was considered as statistically significant.

Data analysis

The data collected from the study was analyzed by using the Statistical Package for Social Scientists (SPSS) version 8.0 for windows to obtain descriptive statistical correlation and the results were presented in form of tables and figures. Statistician was consulted during data analysis.

RESULTS

Acute Toxicity

Ocimum suave leaf extract administered orally up to 10,000 mg/kg to rats was found to cause no death in the two phases of the test. Thus, the LD50 of *Ocimum suave* extract in rats was estimated to be greater than 10,000 mg/kg.

Phytochemical Analysis

Phytochemical analysis of *Ocimum suave* aqueous leaf extract gave positive reactions to phlobatannins, steroids, terpenoids, cardiac glycosides, reducing sugars and tannins.

Table 1: showing the bioactive compounds of *Ocimum suave* aqueous leaf extract

PHYTOCHEMICAL CONSTITUENTS	RELATIVE PRESENCE
Tannins	Positive
Phlobatannins	Positive
Saponins	Negative
Flavonoids	Negative
Steroids	Positive
Terpenoids	Positive
Cardiac glycosides	Positive
Reducing sugars	Positive

Biochemical parameters.

Results expressed as Mean±SEM. Statistical significance tested with student's t-test, $p<0.05$.

ALP levels were found to be higher in the 800mg/kg OSE treated group as compared to the control group with a decrease in 200 and 400mg/kg OSE treated groups. However, the increase was not statistically significant at $p<0.05$ .CK levels were found to be higher in the OSE treated groups as compared to the control group with a decrease in 400mg/kg OSE treated group. The increase of CK levels appeared to be dose dependent. The increase was not statistically significant at $p<0.05$. ASAT levels were higher in the 800mg/kg OSE treated group as compared to the control group with a decrease in 200 and 400mg/kg OSE treated groups.GGT levels were found to be high in all OSE treated groups as compared to the control group. The increase of GGT levels appeared to be dose dependent. The increase was not statistically significant at $p<0.05$. ALAT levels were found to have decreased in all OSE treated groups as compared to the control group.

Table 2 showing the Biochemical parameters.

	TREATMENT			
BIOCHEMICAL PARAMETERS.	**10 ml/kg (control)**	**200 mg/kg**	**400 mg/kg**	**800 mg/kg**
ALPDGKC U/L	252.2±72.652	158.6±70.84	208.8±112.495	365±105.754
CK2RU/L	2287.2±600.45	3864.6±2570.29	1060±528.708	3388±1248.286
GOT-ASATU/L	128.60±114.583	94.4±37.098	92.20±43.929	141.8±55.674
GGTU/L	26.2±8.224	46.80±18.148	69.4±43.929	55.6±22.065
GPT- ALATU/L	189.8±22.758	92.2±37.090	101.2±29.006	136.00±27.395

Hematological values.

Results expressed as Mean±SEM. Statistical significance tested with student's t-test,p<0.05.

WBC increased in the 800mg/kg OSE treated group as compared to the control group with a decrease in 200 and 400mg/kg OSE treated groups. RBC decreased in all OSE treated groups as compared to the control group. Hemoglobin levels were found to be higher in the 800mg/kg OSEtreated group as compared to the control group with a decrease in 200 and 400mg/kg OSE treated groups. Hematocrit percentage was found to be higher in the 800mg/kg OSE treated group as compared to the control group with a decrease in 200 and 400mg/kg SOE treated groups. Mean cell volume increased in the 800mg/kg OSE treated group as compared to the control group with a decrease in 200 and 400mg/kg OSE treated groups. Mean cell hemoglobindecreased in the 200 and 400mg/kg OSE treated groups as compared to the control group with no slight increase in 800mg/kg OSE treated group as compared to the control group. Mean cell hemoglobin concentration decreased in all OSE treated groups as compared to the control group. Platelet count was found to be higher in the 800mg/kg OSE treated group as compared to the control group with a decrease in 200 and 400mg/kg OSE treated groups. Neutrophil percentage was found to be higher in 400 and 800mg/kg OSE treated groups as compared to the control group with a decrease in 200mg/kg group. Lymphocyte percentage was higher in the 800mg/kgas compared to the control group with a decrease in 200 and 400mg/kg OSE treated group. Monocyte percentage was found to be lower in 200 and 800mg/kg groups as compared to the control group. Eosinophil percentage decreased in all OSE treated groups as compared to the control group. Basophil percentage increased in all OSE treated groups as compared to the control group.

Table 3 showing the Hematological values and treatment

Hematological values	TREATMENT			
Haematograms	**l0ML/KG (conti-ol)**	**200MG/KG**	**400MG/KG**	**800MG/KG**
WBC10^{j}µL	9.74±1.697	9.70±3.112	7.42±2.352	12.62±1.705
RBC 10^{c}µL	8.69±0.328	6.79±1.733	6.89±1.759	8.65±0.327
HGB g/dl	14.8±0.586	11.72±2.974	11.72±2.961	15.06±0.453
HCTo/o	46.18±1.893	36.98±9.370	36.90±9.365	47.62±1.271
MCVFI	53.2±1.393	43.8±10.901	42.4±1.656	54.40±2.074
MCHpg	17.42±0.493	13.82±3.465	13.62±3.414	17.46±0.256
MCHCg/dl	32.22 ±0.073	25.38+6.358	25.46±6.377	32.02±0.136
RDW o/o	11.56±0.282	8.98±2.292	9.38±2.414	11.48±0.538
PLTl0^{-j},u,	583.8±128.2575	535.6±182.704	527.2±144.527	616.6±115.289
MPV fl	7.61±0.938	5.50±1.401	7.02±1.771	8.48±0.381
NE%	11.72±1.976	10.42±3.025	14.88±5.068	14.34±3.057
LY%	65.34±5.464	53.22±13.682	44.92±11.647	68.78±5.556
MO%	17.9±3.851	13.72±4.078	17.90±4.506	14.72±2.426
Eo%	4.74±0.946	1.82±0.681	1.66±0.797	2.32±1.063
BA%	0.68±0.37	0.82±0.256	0.84±0.254	1.04±0.268

Results expressed as Mean±SEM. Statistical significance tested with student's t-Test, p<0.05.

There was weight gain between dayl and day7 in 200mg/kg and 400mg/kg OSE-treated groups

compared to the control group with a decrease in day l 800mg/kg OSE- treated group. Between day7 and day 14 weight gain increased in the OSE-treated groups compared to the control group. Between day14 and day 21 weight gain also increased in the OSE-treated groups compared to the control group. There was weight gain between day 21 and day28 in 200mg/kg and 400mg/kg OSE-treated groups compared to the control group with a decrease in day28 800mg/kg OSE-treated group. Between day28 and day 31 weight gain increased in the 200mg/kg and 400mg/kg OSE-treated groups compared to the control group, with a decrease in day28.

Table 4: shows mean body weight of rats

MEAN BODY WEIGHT OF RATS

DURATION	Treatment			
	lOml/kg	**200mg/kg**	**400mg/kg**	**800mg/kg**
Dayl	191.53±1.545	225.1±16.883	219.77±1.048	202.7±1.572
Day 7	210.9±6.31	268.87±7.85	257.87±2.392	234.93±4.129
Day 14	220.2±4.187	288.4±7.275	264.53±5.716	235.7±3.74
Day 21	225.8±0.275	291.57±15.306	280.37±4.715	252.23±7.464
Day 28	243.3±5.285	307.53±16.36	289.37±3.077	239±5.903
Day 31	248.7±3.044	319.2±24.652	289.37±1.184	258.97±6.939

Results expressed as Mean±SEM. Statistical sienificance tested with student's t- Test, $p<0.05$.
There was decrease in relative organ weight of liver in 200mg/kg and 400mg/kg OSE treated groups compared to the control group, with slight increase in 800mg/kg OSE-treated group. Relative organ weight of lungs decreased in 200mg/kg and 400mg/kg OSE-treated groups compared to the control group. There was decrease in relative organ weight of kidney in 200mg/kg and 400mg/kg OSE- treated groups compared to the control group, with an increase in 800mg/kg OSE- treated group. Relative organ weight of testes and stomach decreased in the OSE-treated groups compared to the control group.

Table 5: Shows the relative organ weight

RELATIVE ORGANWEIGHT

	Mean organ weight ±S.E.M (Values are in grams)			
Relative body organ	**lOmVkg**	**200mg/kg**	**400mg/kg**	**800mg/kg**
Liver	2.37±0.67	2.01±0.070	2.13±0.033	2.4±0.058
Lungs	0.47±0.033	0.44±0.031	0.37±0.033	0.47±0.033
Kidney	0.47±0.033	0.41±0.007	0.43±0.033	0.57±0.038
Testes	1.83±0.033	1.26±0.057	1.43±0.033	1.58±0.033
Stomach	1.6±0.0	0.67±0.033	0.67±0.033	0.6±0.0

Values presented as mean ± standard error of mean (S.E.M)

DISCUSSION

The safety of drugs and plant products for human use can be determined using toxicological evaluation which is usually carried out in various experimental animals to predict toxicity and to provide guidelines for selecting a safe dose in humans [3,17, 22-30]. The acute toxicity studies showed that the aqueous leaf extract of *Ocimum suave* has a high safety profile when given orally with an LD50 value greater than 10000 mg/kg body weight. Therefore, the medicinal plant in its local formulation can be categorized as relatively non-toxic based on the method proposed by Lorke (Lorke 1983). Acute toxicity study is a quick and reliable method of assessing the toxic potentials of natural products [5,18,19] Analysis of blood parameters is relevant in risk evaluation as changes in the hematological system have higher predictive value for toxicity studies [30-35]. WBC increased in the 800mg/kg OSE treated group as compared to the control group. The increase inWBC might be due to the increase of the dose. From the observed values of WBC, it is clear that an increase in the WBC count is a normal reaction of rats to foreign substances, which alter their normal physiological process [35-40]. RBC decreased in all OSE treated groups as compared to the control group. The decreased levels of RBC may be due to the low rate of erythropoiesis occurring in the bone marrow of the rats [40-43]. Hemoglobin levels were found to be higher in the 800mg/kg OSE treated group as compared to the control group and the increase might be due to the increase of the dose. Increase in hemoglobin mainly occurs as a result of high altitudes and sickle cell disease. Hematocrit percentage was found to be higher in the 800mg/kg OSE treated group as compared to the control group and the increase as in previous cases might be due to the increase in the dose. Mean cell volume increased in 800mg/kg OSE treated group which was as a result of dose increment. This could have indicated the possibility of liver damage or disease. Platelet count also was found to be higher in the 800mg/kg OSE treated group as compared to the

control group and this indicated platelet aggregates or macroplatelet. Neutrophil percentage increased in the treated groups [400 and 800mg/kg] and this indicated neutrophillia. Neutrophillia occurs as a result of bacterial infections where the neutrophils are involved to fight the infection. Lymphocyte percentage was higher in the 800mg/kg OSE treated group as compared to the control group and this was as a result of dose increment. This increment of lymphocytes indicated lymphocytosis and lymphocytosis occurs mainly when viral infections are present. Monocyte percentage was found to be lower in the treated groups [200 and 800mg/kg] and this indicated monocytopenia. Eosinophil percentage decreased in all OSE treated groups as compared to the control group and this indicated eosinopenia which showed that allergic reactions or parasitic infections were not manifested in the rats. Basophil percentage increased in all OSE treated groups as compared to the control group. This increment of basophil percentage indicated basophillia. Basophillia occurs mainly when allergic reactions are manifested.

ALP levels were found to be higher in the 800mg/kg OSE treated group as compared to the control group. Increase in ALP levels by administration of aqueous leaf extract of *Ocimum suave* showed possible cholestasis which occurred at the dose levels tested since a rise in plasmaALP level is usually a characteristic finding in cholestatic liver disease, an indicator of hepatic toxicity [2,22]. CK levels were found to have increased in the treated groups of rats and this indicated kidney damage. Therefore, the excretory system of animals [rats] exposed to the aqueous leaf extract of *Ocimum suave* may have been slightly affected. AST levels were higher in the treated group [800mg/kg] as compared to the control group. AST is a marker of skeletal muscles damage [23]. Decreased ALT levels in the treated groups indicated that there was no hepatocellular injury or damage. ALT is a cytoplasmic enzyme found in very high concentration in the liver [24], and indicates hepatocellular damage, while AST is less specific than ALT as an indicator of liver function.

Increased or decreased organ weight has been observed as a sensitive indicator of organ toxicity. The aqueous leaf extract of *Ocimum suave* did not produce any demonstrable toxic effects to the relative organ weights of liver, lungs, kidney, testes and stomach. The 200 mg/kg dose decreased the relative organ weights of liver, lungs, kidney, testes and stomach while 800 mg/kg dose increased the relative organ weights of liver and kidney.

CONCLUSION

In conclusion, these results provide evidence for the safety profile of the aqueous leaf extract of *Ocimum suave* in the treatment of the various ailments because the aqueous extract did not produce any significant toxic effects in the organs tested and some haematological and biochemical indices in rats but caution needs to be taken on the appropriate dosage as higher concentration could induce renal toxicity .It can also be concluded that aqueous leaf extract of *Ocimum suave* contains the following secondary metabolites: tannins, phlobatannins, terpenoids, steroids, reducing sugars and cardiac glycosides.

REFERENCES

1. Bishnu, K. (2023). A Review Study of Importance of Herbal Medicine. International Journal for Multidisciplinary Research, Volume 5, Issue 1. doi: 10.36948/ijfmr.2023.v05i01.1667
2. Egba, S. I., Ogbodo, J. O., Ogbodo, P. O. and Obike, C. A. (2017). Toxicological Evaluation of Two Named Herbal Remedies Sold Across Orumba South Local Government of Anambra State, South-Eastern Nigeria. *Asian Journal of Research in Biochemistry*, 1(1):1-6
3. Ravichandran, S., Archana, N., Rai., Jyoti, Rajput., R, M, Madhumitha, Sri. Medicinal plants for curing human diseases. 2023 doi: 10.18282/i-cm.v6i1.570
4. Syed, R. A. and Sahita, K. (2023). The Role of Medicinal Plants in Drug Discovery across the World. Indian Journal of Pure & Applied Biosciences, 1(2), 30-41. doi: 10.18782/2582-2845.8995
5. Jahanger, M. A., Kamal, K., Patra., Sweta, K., Arpit, S., Manika., R, P., Srivastava, G. and Saxena, L. S. (2022). A glance at the phytochemical and ethno pharmacological understanding of four Ocimum species. Current Pharmaceutical Biotechnology, 24(9):1094-1107. DOI: 10.2174/1389201023666221003102423
6. Dhanya, R., Jisna, K., Anas, H. and Fathimathul, R. (2020). Comparative Review on Pharmacognostical and Pharmacological activities of Ocimum Species. Res. J. Pharmacognosy and Phytochem., 12(1): 37-46. doi: 10.5958/0975-4385.2020.00008.

7. Jităreanu, A., Trifan, A., Vieriu, M., Caba, I. C., Mârţu, I. and Agoroaei, L. (2023). Current Trends in Toxicity Assessment of Herbal Medicines: A Narrative Review. Processes, 11(1):83. https://doi.org/10.3390/pr11010083
8. Maryam, A. and Peyman, A. (2023). Potential disorders caused by traditional herbal medicines based on forensic case studies. The Natural products journal, 14, 1. Article ID: e280423216343. DOI: 10.2174/2210315513666230428113918
9. Sankhadip, B., Rana, D. and Kirlin, W, G. (2020). Toxicity Studies Related to Medicinal Plants. In book: Evidance Based Validation of Traditional Medicines. Publisher: Springer Nature, Singapore. doi: 10.1007/978-981-15-8127-4_30
10. Dana-Mihaela, A., Ionela, C., et al., (2020). Human Health Risk Associated with the Use of Products from Contaminated Medicinal Plants. International Conference on e-Health and Bioengineering (EHB), Iasi, Romania, 1-4. doi: 10.1109/EHB50910.2020.9280286
11. Sofowora, A. (1993). Phytochemical Screening of Medicinal Plants and Traditional Medicine in Africa Edition. Spectrum Books Ltd., Nigeria, 150-156.
12. Williams, Charles, Evans. Trease and Evans' Pharmacognosy. 1978
13. Ethical considerations regarding animal experimentation. doi: 10.15167/2421-4248/jpmh2022.63.2s3.2768
14. Reitman, S. and Frankel, S. (1957). A colorimetric method for thedetermination of serum glutamateoxaloacetate and pyruvatetransaminase. *American Journal of Clinical Pathology*., 28: 56-63.
15. Henry, J. B. (1979). Clinical Diagnosis and Management by Laboratory Methods W.B Saunders and Company, Philadelphia, PA p365.
16. Teitz, N. N. (1987). Fundamental of Clinical Chemistry ed 3 Philadephia, W.B Saunders Co. pg 391
17. Mwandah, D. C., Ntulume, I., Aliero, A. A., Kiyimba, K., Ayikobua, E. T., Bwanika, R. and Oloro, J. (2019). Evaluation of Sub-acute and Sub Chronic Toxicity Profile of the Aqueous Leaf Crude Extract of Melanthera Scandens (Schumach & Thonn) in Wistar Rats. Journal of Complementary and Alternative Medical Research, 8(3): 1-16.
18. Mwandah, D. C., Ntulume, I., Aliero, A. A., Kiyimba, K., Ayikobua, E. T., Bwanika, R. and Oloro, J. (2019). Evaluation of Sub-acute and Sub Chronic Toxicity Profile of the Aqueous Leaf Crude Extract of Melanthera Scandens (Schumach & Thonn) in Wistar Rats. Journal of Complementary and Alternative Medical Research., 8(3): 1-16
19. Adiukwu, P. C., Amon, A., Nambatya, G., Adzu, B., Imanirampa, L., Twinomujuni, S. and Katusiime, B. (2012). Acute toxicity, antipyretic and antinociceptive study of the crude saponin from an edible vegetable: Vernonia amygdalina leaf. *International Journal of Biological and Chemical Sciences*, 6(3), 1019-1028.
20. Orji, E. A., Egba, S. I. and Mgbenka, B. O. (2016). Influence of Sub-chronic Administration of Friut Extracts of *Xylopia aethiopica* on Haematopoietic System of Male Wistar Albino Rats. *Asian Journal of Biology*, 4(1): 1-8
21. Mfitundinda, W., Odda, J. and Kirimuhuzya, C. (2022). Evaluation of the Acute Toxicity and Hematological Effect of Aqueous Extract of Albizia chinensis (Osbeck) Merr Stem Bark in Streptozotocin-induced Diabetic Wistar rats. Journal of Biological Sciences, 9(1):146-158
22. Ukpabi-Ugo Jacinta Chigozie., Monanu, Michael Okechukwu., Patrick-Iwuanyanwu, Kingsley and Egbachukwu Simeon Ikechukwu. (2016). Potential hepatoprotective effect of different solvent fractions of *Ocimum gratissimum* (O G) in a paracetamol-induced hepatotoxicity in Wistar albino rats. *ScopeMed*., 5(1): 10-16
23. Aja, P. M., Igwenyi, I. O., Okechukwu, P. U., Orji, O. U. and Alum, E. U. (2015). Evaluation of anti-diabetic effect and liver function indices of ethanol extracts of Moringa oleifera and Cajanus cajan leaves in alloxan induced diabetic albino rats. *Global Veterinaria*, 14(3), 439-447.23
24. Offor, C. E., Uko, A. U., Alum, E. U., Ugwu, P.C.O. and Agbafor, K.N. (2015). Effect of Ethanol Leaf-Extract of *Annona muricata* on Liver Enzymes of Albino Rats. *IOSR Journal of Nursing and Health Science (IOSR-JNHS)*, **4(5):** 99-103.
25. Okechukwu, P. U., Okwesili, F. N., Parker, E. J., Abubakar, B., Emmanuel, C. O., & Christian, E. O. (2013). Phytochemical and acute toxicity studies of Moringa oleifera ethanol leaf extract. *International Journal of Life Science BiotechNology and Pharma Research*, 2(2), 66-71.

26. Odo, C. E., Nwodo, O. F., Joshua, P. E., Ugwu, O. P., & Okonkwo, C. C. (2013). Acute toxicity investigation and anti-diarrhoeal effect of the chloroform–methanol extract of the seeds of Persea americana in albino rats. *journal of pharmacy research*, *6*(3), 331-335.
27. Adonu Cyril, C., Ugwu, O. P. C., Esimone Co, O., Bawa, A., Nwaka, A. C., & Okorie, C. U. (2013). Phytochemical analyses of the menthanol, hot water and n-hexane extracts of the aerial parts of cassytha filiformis (Linn) and leaves of cleistopholis patens. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, *4*, 1143-1149.
28. Orji, O. U., Ibiam, U. A., Aja, P. M., Ugwu, P., Uraku, A. J., Aloke, C., ... & Nwali, B. U. (2016). Evaluation of the phytochemical and nutritional profiles of Cnidoscolus aconitifolius leaf collected in Abakaliki South East Nigeria. *World Journal of Medical Sciences*, *13*(3), 213-217.
29. Offor, C. E., Ugwu, P. C., Okechukwu, P. M., & Igwenyi, I. O. (2015). Proximate and phytochemical analyses of Terminalia catappa leaves. *European Journal of Applied Sciences*, *7*(1), 09-11.
30. Nwali, B. U., Egesimba, G. I., Ugwu, P. C. O., & Ogbanshi, M. E. (2015). Assessment of the nutritional value of wild and farmed Clarias gariepinus. *International Journal of Current Microbiology and Applied Sciences*, *4*(1), 179-182.
31. Afiukwa, C. A., Igwenyi, I. O., Ogah, O., Offor, C. E., & Ugwu, O. O. (2011). Variations in seed phytic and oxalic acid contents among Nigerian cowpea accessions and their relationship with grain yield. *Continental Journal of Food Science and Technology*, *5*(2), 40-48.
32. Aja, P. M., Okechukwu, P. C. U., Kennedy, K., Ibere, J. B., & Ekpono, E. U. (2017). Phytochemical analysis of Senna occidentalis leaves. *IDOSR J Appl Sci*, *2*(1), 75-91.
33. Igwenyi, I. O., Isiguzo, O. E., Aja, P. M., Ugwu Okechukwu, P. C., Ezeani, N. N., & Uraku, A. J. (2015). Proximate composition, mineral content and phytochemical analysis of the African oil bean (Pentaclethra macrophylla) seed. *American-Eurasian J Agric Environ Sci*, *15*, 1873-1875.
34. Orji, O. U., Ibiam, U. A., Aja, P. M., Ugwu, P., Uraku, A. J., Aloke, C., ... & Nwali, B. U. (2016). Evaluation of the phytochemical and nutritional profiles of Cnidoscolus aconitifolius leaf collected in Abakaliki South East Nigeria. *World Journal of Medical Sciences*, *13*(3), 213-217.
35. Offor, C. E., Ugwu, P. C., Okechukwu, P. M., & Igwenyi, I. O. (2015). Proximate and phytochemical analyses of Terminalia catappa leaves. *European Journal of Applied Sciences*, *7*(1), 09-11.
36. Afiukwa, C. A., Ugwu, O. P., Ebenyi, L. N., Oketa, H. A., Idenyi, J. N., & Ossai, E. C. (2013). Phytochemical analysis of two wild edible mushrooms, Auricularia polytricha and Pleurotus ostreatus, common in Ohaukwu area of Ebonyi state, Nigeria. *Res J Pharm Biol Chem Sci*, *4*(2), 1065-70.
37. Chukwuemeka, I. M., Udeozo, I. P., Mathew, C., Oraekwute, E. E., Onyeze, R. C., & Ugwu, O. P. C. (2013). Phytochemical analysis of crude ethanolic leaf extract of Morinda lucida. *Int. J. Res. Rev. Pharm. Appl. Sci*, *3*(4), 470-475.
38. Udeozo, I. P., Nwaka, A. C., Ugwu, O. P., & Akogwu, M. (2014). Anti-inflammatory, phytochemical and acute toxicity study of the flower extract of Newbouldia laevis. *Int J Curr Microbiol App Sci*, *3*(3), 1029-35.
39. Afiukwa, C. A., Ugwu Okechukwu, P. C., Ebenyi, L. N., Ossai, E. C., & Nwaka, A. C. (2013). Phytochemical analysis of three wild edible mushrooms, coral mushroom, Agaricus bisporus and Lentinus sajor-caju, common in Ohaukwu Area of Ebonyi State, Nigeria. *International Journal of Pharmaceutics*, *3*(2), 410-414.
40. Ugwu O.P.C., and Amasiorah, V. I. (2020). The effects of the crude ethanol root extract and fractions of Sphenocentrum jollyanum on hematological indices and glycosylated haemoglobin of streptozotocin-induced diabetic albino rats. *INOSR Scientific Research*, *6*(1), 61-74.
41. Ikechukwu, A. A., Ibiam, U. A., Okechukwu, P. U., Inya-Agha, O. R., Obasi, U. O., & Chukwu, D. O. (2015). Phytochemistry and acute toxicity study of Bridelia ferruginea extracts. *World J. Med. Sci*, *12*(4), 397-402.
42. Igwenyi, I. O., Dickson, O., Igwenyi, I. P., Okechukwu, P. C., Edwin, N., & Alum, E. U. (2015). Properties of Vegetable Oils from Three Underutilized Indigenous Seeds. *Global Journal of Pharmacology*, *9*(4), 362-365.
43. Ibiam, U. A., Alum, E. U., Aja, P. M., Orji, O. U., Nwamaka, E. N., & Ugwu, O. P. C. (2018). Comparative Analysis Of Chemical Composition Of Buchholzia Coriacea Ethanol Leaf-Extract, Aqueous And Ethylacetate Fractions. *Indo American Journal Of*

Pharmaceutical Sciences, 5(7), 6358-6369.

CITE AS: Kioko Lucy Mutindi (2024). Evaluation of Subchronic toxicity and phytochemical analysis of aqueous extract of Ocimum suave (Lamiciae). IAA Journal of Applied Sciences 11(2):50-59. https://doi.org/10.59298/IAAJAS/2024/112.50.59