International Research Journal of Pharmacy and Medical Sciences
ISSN (Online): 2581-3277

Modulatory Effects of Aqueous Leaf Extract of Ocimum basilicum on the Lipid Profiles and Body Weight of Male Wistar Rats, Exposed to Sodium Arsenite

Ojeka, Sunday Ogbu[1], Onungwe, Belinda Chinwendu[1], Zabbey, Victor Zigabelbari[1*], Onwoke, Ebibi Elizah[2]

[1]Department of Human Physiology, Faculty of Basic Medical Sciences, College of Health Science, University of Port Harcourt, Rivers State, Nigeria

[2]Department of medical Physics, Faculty of Science, Federal University of Health Sciences, Otukpo, Benue State, Nigeria

E-mail: sunday.ojeka@uniport.edu.ng; belindaonungwe@mail.com; zabbeyvictor@gmail.com, Ebibi.onwoke@fuhso.edu.ng

Abstract—Background*: Medicinal plants have been employed to prevent and ameliorate many disorders and health conditions including toxicities and failing health conditions. This study aims to investigate the Modulatory Effects of Aqueous Leaf Extract of Ocimum basilicum on the Lipid Profiles and Body Weight of Male Wistar Rats, Exposed to Sodium Arsenite.* ***Methods****: The study was carried out using 48 male Wistar rats weighing 160-250g, divided into eight (8) groups, each containing 6 rats. Group 1 served as negative control and received only distilled water. Group 2 was the positive control and received 6mg/kg of body weight of Sodium arsenide only. Groups 3, 4 and 5 received the aqueous leaf extract of Ocimum basilicum (ALEOB) in concentrations of 400mg/kg, 600mg/kg and 800mg/kg of body weight respectively while groups 6, 7 and 8 received 6mg/kg of body weight of Sodium arsenide and ALEOB in concentrations of 400mg/kg, 600mg/kg and 800mg/kg of body weight respectively for 6 weeks.* ***Results****: At the end of the experimentation, the animals were weighed and sacrificed and blood samples were collected to determine the biochemical parameters. The ALEOB was found to cause a significant decrease in the concentration of Total cholesterol (TC), Triglycerides (TG) and very low-density lipoprotein (VLDL), while causing a significant increase in High density lipoprotein cholesterol. It was also found to ameliorate the adverse toxicity caused by Sodium Arsenite on TC, TG, HDL-C and VLDL. It also caused an insignificant increase in body weight.* ***Conclusio****n: The ALEOB was found to have an ameliorative effect on Sodium Arsenide induced toxicity on the lipid profile and body weight of the experimental rats*.

Keywords— *Modulatory effects, Lipid profile, low density lipoprotein, ameliorative effect and toxicity*.

I. INTRODUCTION

As the years go by, humans have been overwhelmingly exposed to toxicants in their environment both directly or through indirect sources. These toxic substances form a major addictive to drugs in pharmaceutical industries, present as preservatives for food, suffused in pesticides, and in underground sources of water. [1] Exposure of the body to these toxicants causes them to spread to several organs of the body, such as the kidney, liver, lungs and the skin. [2] Oral consumption of these toxicants exposes the liver to inflation/ toxicity before any other organ. Excretion of the metabolites of these toxicants takes place through the kidney.

The exposure of these organs to these highly toxic substances over a period of years, leads to inflammation of the liver and the kidney. This progresses to hepatic and renal failure and diseases which is increasingly a major global health burden, which is estimated to become the fifth most common cause of death globally.

The use of plants as herbs have been established by several studies and this has been used by man as an age long practice. The use of herbs to treat ailment, is of similar relevance as food to man. Several works of literature have shown that various herbs can be used for the treatment of diseases for both preventive and curative purposes. Natural herbs such as Ginger, Neem, Olive, Basil, Syzygium cumini etc have been used as orthodox remedies for the treatment of disorders of the liver and kidney with a significant ameliorative effect. [3,4] These vegetables and spices have been well documented to have active ingredients that have antioxidative, medicinal, antibacterial antiviral, antimicrobial, and anticarcinogenic effects. [5]

Ocimum basilicum is an annual and perennial plant, which can be propagated by the use of its seed or stem cutting. Its edible parts are the leaves and flowers in tea and as flavoring. It can grow to a height of zero feet four inches to three feet zero inches and a width of zero feet four inches to one foot two inches. The leaf colour can be green, purple, variegated and white. Perky green leaves are immediately linked to the stem's base. It is an annual herb with a height range 30cm to 60cm and it can germinate fourteen to twenty-one days after sowing. Small, fragrant, and coming in shades of white, red, and violet, basil blooms have tiny, black seeds. Its growth season lasts between one hundred and seventy to one hundred and eighty days under ideal environmental conditions. Two to three times during the growth season, harvesting is done.

O. BASILICUM has been found to possess nutraceutical attributes especially considering its rich proximate

Ojeka, Sunday Ogbu; Onungwe, Belinda Chinwendu; Zabbey, Victor Zigabelbari: and Onwoke, Ebibi Elizah, "Modulatory Effects of Aqueous Leaf Extract of Ocimum basilicum on the Lipid Profiles and Body Weight of Male Wistar Rats, Exposed to Sodium Arsenite," *International Research Journal of Pharmacy and Medical Sciences (IRJPMS)*, Volume 7, Issue 2, pp. 24-28, 2024.

constituents. [6] Nutraceuticals are active compounds, which apart from nourishment, also have therapeutic value.

Sodium arsenide exposure occurs worldwide via operational and environmental distributions. It is commonly found in the soil, rock, wells, and other large bodies of water. It is used in herbicides, fungicides, insecticides and algaecide and rodenticide production. [1] It is dispersed either naturally or anthropogenically into the environs. The natural means is via volcanic events, weathering of deposited rocks, and soil erosion while the anthropogenic route is via smelting (segregation of metal from rock) for industrial use.

Sodium arsenide is produced when arsenite reacts with water,[7] as represented by the equation below:

Equation 1: $As_2O_3 + H_2O \longrightarrow 2HAsO_2$

Equation 2: $As_2O3 + 2NaOH \longrightarrow 2NaAsO_2 + H_2O$

Inorganic Arsenide is basically broken down in a reduction of pentavalent Arsenide (arsenate) to trivalent Arsenide followed by oxidative addition of methyl clusters. Arsenide is immersed into the blood stream and is taken up by blood cells, and other cells which reduce arsenate to Arsenite, then it undergoes biomethylation in the liver.

Most heavy metals are seen in the climate and diet. In limited quantities they are expected to help keep up with sound health yet in higher levels, they can become poisonous or risky. These metals adverse effects can bring down energy levels and harm the efficiency of most organs of the body. Long time of contacts with these metals can prompt steadily advancing physical, strong, and neurological degenerative tendencies that stimulate varied pathogenesis like sclerosis, Parkinsonism, Alzheimer's disease and solid dystrophy. A very long exposure to certain metals and their mixtures might bring about commencement of different ailments.

The lipid profile test is used to diagnose dyslipidemia, hyperlipidemia, hypercholesterolemia and hypertriglyceridemia. When the cholesterol level is high, this could be due to high HDL levels, which can prevent heart disease. A total cholesterol level indicates there may be disturbances with cholesterol levels but the components which make up the total cholesterol shows the levels of the bad cholesterol which are Low Density Lipoprotein and very low-density lipoprotein.

Dyslipidemia is an abnormal concentration of specific types of cholesterol or lipoprotein molecules. In dyslipidemia, an elevated concentration of low-density lipoprotein is observed with a decrease in HDL-C. Hypercholesterolemia is an increase in the concentration of the total cholesterol molecules in the blood. An elevated concentration of the total cholesterol would lead to an increase in the concentration of low-density lipoprotein and a decrease in the concentration of high-density lipoprotein.

II. Materials and Methods

This study was a laboratory-based study and used animal models only. The experimental animals were acquired and housed at the institutional animal house of the Department of Human Physiology, Faculty of Basic Medical Sciences, University of Port Harcourt. After a week of acclimatization, the experimentation started. A total of forty-eight (48) male Wistar rats weighing between 180g and 200g, arbitrarily distributed into eight groups of six rats each were used for the study. The animals were housed in the Animal House of the Faculty of Basic Medical Sciences, University of Port Harcourt. They were initially acclimatized for fourteen days to their new handling and environment after which they were divided into eight (8) groups

The *Ocimum BASILICUM* leaves were purchased from an indigenous market in Port Harcourt, Rivers State in the early hours of the morning at about 6:30am. It was identified and authenticated at the universities' herbarium. The leaves were collected, washed and air-dried at room temperatures for 10 days. The dried leaves were ground into powder using blender and about 1800g/1.8kg of ground powder was obtained. The powdery sample leaf was soaked in distilled water for 48 hours. The aqueous extract was obtained according to the procedure earlier described. [8] The powder was then mixed with 500ml boiling water by magnetic stirrer for ten minutes. Then the extract was filtered over Whatman No.1 paper. The filtrates were frozen and lyophilized in a lyophilizator at 5mmHg pressure and at minus fifty degree Celsius (Labconco, Freezone 1L). The extracts were placed in a plastic bottle and stored at minus twenty degree Celsius until used. The solvent was removed using a rotary evaporator. The aqueous extract was formulated at graded doses of 400mg, 600mg, and 800mg/kg of body weight and administered using the oral incubators or oral gavage

The experimental protocol is as shown in the table below:

Groups	Treatment	Procedure and Duration
1	Distilled water.	The animals were fed with rat pellets and water only for the period of the experiment.
2	6mg/kg sodium arsenide dissolved in water.	The rats were administered orally with a dose of 6mg/kg body weight of Sodium arsenide once every day for 4 weeks
3	400 mg/kg of aqueous *O. basilicum* extract.	The rats were administered a dose of 400 mg/kg of only *O. BASILICUM* extract daily for 4 weeks.
4	600 mg/kg of aqueous *O. basilicum* extract only	The rats were administered with 600 mg/kg of only *O. BASILICUM* extract daily for 4 weeks.
5	800 mg/kg of aqueous *O. basilicum* extract.	The rats were administered with 800mg/kg of only *O. BASILICUM* extract daily for 4 weeks.
6	6mg/kg of Sodium arsenide and 400 mg/kg of aqueous *O. basilicum* extract	The rats were administered with both 6mg/kg of Sodium arsenide and 400 mg/kg of *O. BASILICUM* extract daily for 4 weeks.
7	6mg/kg of Sodium arsenide and 600 mg/kg of aqueous *O. basilicum* extract	The rats were administered with both 6mg/kg of Sodium arsenide and 600mg/kg of *O. BASILICUM* extract daily for 4 weeks.
8	6mg/kg of Sodium arsenide and 800 mg/kg of aqueous *O. basilicum* extract	The rats were administered with both 6mg/kg of Sodium arsenide and 800 mg/kg of *O. BASILICUM* extract daily for 4 weeks.

At the expiration of the twenty-eight days of extract administration, the rats were sacrificed through cervical dislocation. Blood samples were collected, taken into a fresh, dry centrifuge tube. After the blood had been allowed to

Ojeka, Sunday Ogbu; Onungwe, Belinda Chinwendu; Zabbey, Victor Zigabelbari: and Onwoke, Ebibi Elizah, "Modulatory Effects of Aqueous Leaf Extract of Ocimum basilicum on the Lipid Profiles and Body Weight of Male Wistar Rats, Exposed to Sodium Arsenite," *International Research Journal of Pharmacy and Medical Sciences (IRJPMS)*, Volume 7, Issue 2, pp. 24-28, 2024.

coagulate for thirty minutes at room temperature, serum was produced by centrifuging the blood for fifteen minutes at three thousand revolution-rpm. The serum was then collected into a clean dry sample bottle and frozen, from where the determination of the lipid profile was done. The plain bottles were labelled appropriately according to the administered substances.

The body weights of the rats were also measured using weighing scale on the 1st and last days of the experiment.

All statistical analysis was done using Statistical Package for Social Sciences (SPSS) software, SPSS Inc., Chicago, Standard version 25.0. The results were shown as mean ± Standard error of mean. Differences between the groups were analysed by one-way Analysis of Variance (ANOVA). P-values< 0.05 were considered statistically significant for differences in mean.

III. Results and Discussion

Table 1: Effect of ALEOB Treatment on lipid profile of the experimental animals

Groups	TC (mmol/l)	TG (mmol/l)	HDL-C (mmol/l±)	LDL-C (iul/L±SEM)	VLDL (iul/L)
1	7.33±1.88	1.33±0.33	2.33± 0.33	5.66± 0.88	0.63± 0.33
2	7.98±2.00[a]	1.73±0.33[a]	1.23± 0.33	6.33± 0.33 [a]	0.97± 0.33 [a]
3	6.28± 1.33[a]	1.23±0.33	2.42± 0.66	5.00± 0.57	0.52± 0.33
4	5.33± 1.53[a]	0.66±0.66 [a]	3.00± 0.00 [a]	5.34± 0.00	0.40± 0.33
5	5.16± 0.93[a]	0.46±0.33 [a]	3.67± 0.33 [a]	5.84± 0.33	0.38± 0.33 [a]
6	7.66± 1.53	1.67±0.66	1.33± 0.88	6.28± 0.88	0.66± 0.33
7	7.43± 1.47	1.50±0.33	2.00± 0.57	6.14± 0.33	0.60± 0.00
8	7.36± 1.33[b]	1.11±0.00[b]	2.45± 0.33[b]	5.90± 0.57	0.57± 0.00[b]

All values are presented as mean ± SEM; n=6; [a] significant change at p<0.5 when compared with group 1; [b] Significant change at p<0.5 when compared with group 2.

Table 2: Mean changes in the body weight following administration of leaf extract of *O. BASILICUM* at different concentration and Sodium arsenide

Groups	Day 1 (g± SEM)	Day 28 (g± SEM)	Increase in body weight (g± SEM)
1	180.66±3.63	211.50±2.88	30.83±5.46
2	204.50±13.42	223.00±10.91	18.50±20.22
3	185.60±9.53	227.40±8.89	41.80±12.35
4	187.80±6.41	234.60±6.28	46.80±10.27
5	188.80±7.50	237.46±10.05	48.66±12.51
6	189.20±6.22	213.20±6.08	24.00±11.27
7	194.20±8.13	224.00±6.49	29.80±12.13
8	202.40±13.58	234.00±18.87	31.60±7.18

All values are presented as mean ± SEM; n=6; [a] significant change at p<0.5 when compared with group 1; [b] Significant change at p<0.5 when compared with group 2.

Effect of ALEOB Treatment on lipid profile of the rats

From table 1 above, it was found that Sodium Arsenite caused a significant increase in the level of total cholesterol (TC). There was also found a significant decrease in the level of TC in groups 3, 4 and 5, with respect to the negative control group. In group 8, the ALEOB was able to significantly reduce the concentration of TC with respect to the positive control. The results on the concentration of triglycerides (TG) revealed a significant elevation caused by sodium Arsenite, with respect to the negative control group. Again, there were significant decreases in the concentration of TG in groups 4 and 5, with respect to the negative control group. In group 8, the ALEOB was able to significantly reduce the concentration of TG with respect to the positive control group. The results on the concentration of high-density lipoprotein cholesterol showed a significant elevation in groups 4 and 5, with respect to the negative control group. There was an insignificant decrease in the plasma level in group 2, when compared to the negative control group. There was also a significant increase in group 8 with respect to the positive control group. The results on the concentration of low-density lipoprotein cholesterol (LDL-C) showed a significant elevation in group 2, with respect to the negative control group. Finally, the results on the concentration of very low-density lipoprotein (VLDL) showed a significant elevation in group 2 and a significant decrease in 5, both with respect to the negative control group. There was also a significant decrease in the level of VLDL in group 8, when compared with group 2.

The liver is an essential organ that plays an important role in detoxification, maintenance of lipid balance and protection against chemical toxicity. [9,10] Disruption of serum and cellular lipid levels is as a result of the presence of Arsenide destroying liver function, which in turn leads to the genesis of liver diseases. From this study, there was observed dyslipidemia, hyperlipidemia, and hypercholesterolemia which could be attributed to the toxic effect of Sodium arsenide on the hepatocytes of the liver or its inability to take the lipids from circulation with its resultant increase in lipid levels in the blood. An increase in triglycerides, total cholesterol, low density lipoprotein and VLDL and a decrease in HDL-C level observed from the study is similar to results obtained from other studies on Arsenide at dose 3mg/kg, 10mg/kg. [11,5,12] The significant increase in triglyceride in group 2 (positive control) could be related to an elevation of free fatty acids levels in the blood.

The total cholesterol elevation may be caused by the negative impacts of Arsenide which causes an increased activity of the 3-hydroxy-3-methyl-glutaryl CoA (HMG-CoA) reductase enzyme. HMG-CoA reductase reaction is the rate limiting step in the synthesis of alcohol for the catalyzed production of mevalonate from HMG-CoA. As a result, extra cholesterol is produced and accumulates as a result of the raised HMG-CoA reductase activity. [11] Lecithin cholesterol acyltransferase (LCAT) is also decreased by arsenide. The LCAT enzyme functions in transporting cholesterol out of the circulation and tissues during the formation of cholesterol esters from HDL. This ensures that HDL transports the cholesterol to the liver and immediately the cholesterol is removed from the body.

Previous studies in which rats were fed with high fat feed to induce hyperlipidaemia, the methanolic leaf extract and essential oil of *O. BASILICUM* HAD DEMONSTRATED AN AMELIORATIVE EFFECT ON LIPID PROFILE. DECREASE IN TOTAL CHOLESTEROL, TRIGLYCERIDE, LOW Density Lipoprotein AND HDL cholesterol levels have been observed in the studies conducted by another group of research. [13,14,15] In their studies, they agreed that the leaf extract of O. basilicum had profound anti-hyperlipedemic activity which can be attributed to its phytochemical constituents which aid lipid elimination from the body. [16] The ALEOB has more anti-hyperlipidemic effect which was observed in groups 5 and 8 that received high doses of it when compared to the control.

Ojeka, Sunday Ogbu; Onungwe, Belinda Chinwendu; Zabbey, Victor Zigabelbari: and Onwoke, Ebibi Elizah, "Modulatory Effects of Aqueous Leaf Extract of Ocimum basilicum on the Lipid Profiles and Body Weight of Male Wistar Rats, Exposed to Sodium Arsenite," *International Research Journal of Pharmacy and Medical Sciences (IRJPMS)*, Volume 7, Issue 2, pp. 24-28, 2024.

Sodium arsenide caused a decrease in the HDL-C level following its administration when compared to the negative control (group 1). At high doses of ALEOB, the HDL-C level was elevated when compared to the negative control. The HDL-C level is a good indicator of a healthy heart, hormones, tissues and the formation of bile. HDL-C helps to carry cholesterol, phospho-lipids from tissues and organs to the liver for degradation and elimination. The higher the HDL-C levels the better for the heart. Also, the Low-Density Lipoprotein and very Low-Density Lipoprotein levels increased when Sodium arsenide was administered, the ameliorative effect of ALEOB was observed in the reduction of the levels of triglycerides, Low Density Lipoprotein and VLDL levels at high concentrations of the ALEOB.

These results agree with the previous works by many researchers, which state that ALEOB may contain phytochemicals capable of lowering the plasma lipid concentration. [13,17]

When the effects of purple O. basilicum methanolic extract and essential oil were compared on serum lipid profiles in rats fed a high cholesterol diet, the extract reduced hepatic triglyceride by 16.4 percent and total cholesterol by 22.1 percent. [13] The hyperlipidemic activity of O. basilicum extract was investigated by others and they observed that it significantly lowered the plasma triglyceride and cholesterol in cases of induced hyperlipidemia. [18] Again, when suave (OS) and O. basilicum (OB) were evaluated to determine their abilities to prevent high fat diet (HFD) induced Hyperlipidemia and oxidative stress in Wistar albino rats which were given daily oral doses of 800 mg/kg of extracts of O. suave or O. basilicum for 21 days, the administration of the aqueous extract of O. suave or O. basilicum to HFD fed rats significantly prevented the HFD induced increases in serum total, high-density lipoprotein (HDL) and low-protein lipoprotein (LDL-C) cholesterol, while partially, though significantly, prevented the HFD induced decrease in serum triacylglycerols. [15] When an assessment was done on the effect of raw and irradiated basil on the damage of the heart in rats exposed to Arsenide, it was concluded that Sweet basil extract contained phytochemical content which affected the metabolism of lipid. [11] This is demonstrated in the intervention of sweet basil extract with a dosage of 1.06 g/ 20 g body weight for 15 days, which caused a decrease in total cholesterol, triglycerides, LDL-C and an increase of HDL-C.

The ameliorative ability of Ocimum basilicum disrupted lipid concentration maybe due to the presence of flavonoids, beta carotene, and tannins. [11] Flavonoids and beta carotene could inhibit HMGCoA reductase which is known to function as a catalyst in the formation of cholesterol. HMG-CoA reductase inhibition leads to reduced cholesterol concentration in hepatocytes and therefore upregulation of LDL-C receptors. The increasing hepatic availability of LDL-C receptors leading to the accelerated clearance of LDL-C and VLDL. [19] The increased clearance of LDL-C and VLDL is responsible for the reduction of LDL-C cholesterol and triglyceride levels in plasma. Flavonoids can also improve LCAT function, which leads to increase in serum HDL levels. [20] Furthermore, tannins can reduce cholesterol and LDL-C by increasing their rates of metabolism into bile acids and increase the excretion of bile acids through feces. [21]

Mean changes in the body weight following administration of leaf extract of O. BASILICUM at different concentration and Sodium arsenide

There was an observable actual weight gain in both the control and experimental groups. However, there was a decrease in the relative weight gain in group 2, with respect to group 1. There was also found a statistically insignificant increase in relative weight gain in groups 3, 4 and 5 when compared with group 1. This indicates that the extract may have the tendency of increasing the body weight. Again, there was found an insignificant increase in the relative weight gain in groups 6, 7 and 8, with respect to group 2. This indicates the capacity of the extract to reverse the toxicity cause by Sodium Arsenite on the body weight.

Body weight change has been used as a veritable tool in toxicological studies and has been recommended to be measured in experimental studies to evaluate the effect of chemicals and extract administration. [22] Changes in body weight after administration of aqueous leaf extract of Ocimum basilicum has been used as an indispensable index of growth. [23,3]

IV. CONCLUSION

In conclusion, the study investigating the modulatory effects of aqueous leaf extract of Ocimum basilicum on the lipid profiles and body weight of male Wistar rats, exposed to Sodium arsenide has provided some valuable insights. The findings suggest that the administration of the Ocimum basilicum extract may have a positive impact on mitigating the adverse effects induced by sodium Arsenite. The observed alterations in the lipid profile, particularly the reduction in LDL levels, imply a potential protective effect against cardiovascular risks associated with Sodium Arsenite toxicity. The extract's ability to modulate lipid parameters could contribute to maintaining a healthier cardiovascular profile in the face of arsenic-induced stress. Furthermore, the study highlights the potential of Ocimum basilicum as a natural remedy in counteracting the detrimental effects on body weight caused by Sodium Arsenite. The extract may play a role in preventing or reversing the weight loss associated with arsenic toxicity, thereby promoting overall well-being in the experimental rats.

Summarily, the results of this study suggest that the aqueous leaf extract of Ocimum basilicum holds promise as a potential therapeutic agent in mitigating the impact of Sodium Arsenite-induced toxicity on lipid profile and body weight in male Wistar rats. These findings have contributed to the growing body of knowledge on the medicinal properties of Ocimum basilicum and may pave the way for future research in the field of natural remedies for environmental toxin-induced health challenges

Ethical Approval

The ethical approval to carry out this work was sought for and obtained from the ethics and research committee of the University of Port Harcourt and preserved by the author(s).

Ojeka, Sunday Ogbu; Onungwe, Belinda Chinwendu; Zabbey, Victor Zigabelbari: and Onwoke, Ebibi Elizah, "Modulatory Effects of Aqueous Leaf Extract of Ocimum basilicum on the Lipid Profiles and Body Weight of Male Wistar Rats, Exposed to Sodium Arsenite," *International Research Journal of Pharmacy and Medical Sciences (IRJPMS)*, Volume 7, Issue 2, pp. 24-28, 2024.

Acknowledgements
The authors would like to express warm appreciation to Professor D.V. Dapper of the Department of Human Physiology, College of Health Sciences, University of Port Harcourt, Nigeria for his immense technical assistance.
Competing interests
Authors have declared that no competing interests exist.
Authors' contributions
Author Ojeka, S.O conceived the study and designed the protocol while author Onungwe, B.C, coordinated the experiment and contributed in the manuscript writing. Author Zabbey, V. Z performed the statistical analysis and data interpretation while author Onwoke, E.E carried out the laboratory procedures and also contributed in the manuscript writing. All authors read through and approved the final manuscript.

REFERENCES

1. Gbadegesin, M. A., & Odunola, O. A. (2010). Aqueous and ethanolic leaf extracts of Ocimum basilicum (sweet basil) protect against Sodium Arsenite-induced hepatotoxicity in Wistar rats. Nigerian Journal of Physiological Sciences, 25(1): 29-36.
2. Saha, J. C., Dikshit, A. K., Bandyopadhyay, M., & Saha, K. C. (1999). A review of arsenic poisoning and its effects on human health. Critical reviews in environmental science and technology, 29(3): 281-313.
3. Ahmed, D., & Aujla, M. I. (2012). Ocimum basilicum: a review on phytochemical and pharmacological studies. Pak. J. Chem, 2(2), 78-85.
4. Hassan pouraghdam, M. B., Hassani, A., & Shalamzari, M. S. (2010). Menthone-and estragole-rich essential oil of cultivated Ocimum basilicum L. from Northwest Iran. Chemija, 21(1): 59-62.
5. Ojo, O.A., A.B. Ojo, O. Awoyinka, B.O. Ajiboye, B.E.,Oyinloye, O.A. Osukoya, I.I. Olayide, and A. Ibitayo, (2018). Aqueous extract of Carica papaya Linn. Roots potentially attenuates arsenic induced biochemical and genotoxic effects in Wistar rats. Journal of Traditional and Complementary Medicine,. 8(2): 324-334.
6. Chenni, M., El Abed, D., Rakotomanomana, N., Fernandez, X., & Chemat, F. (2016). Comparative study of essential oils extracted from Egyptian basil leaves (Ocimum basilicum L.) using hydro-distillation and solvent-free microwave extraction. Molecules, 21(1), 113.
7. Anifowose, O. (2014). protective effect of aqueous extracts of aframomum longiscapum seed against sodium arsenite-induced hepatotoxicity and clastogenicity in wistar rats (Doctoral dissertation).
8. Gülçin, I., Elmastaş, M., & Aboul-Enein, H. Y. (2007). Determination of antioxidant and radical scavenging activity of Basil (Ocimum basilicum L. Family Lamiaceae) assayed by different methodologies. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives, 21(4):354-361.
9. Gu, X. and J.E. Manautou (2012). Molecular mechanisms underlying chemical liver injury. Expert Reviews in Molecular Medicine,14:1-24.
10. Browning, J.D. and J.D. Horton (2004). Molecular mediators of hepatic steatosis and liver injury. The Journal of Clinical Investigation, 114(2):147-152.
11. Ghazwani, A. H., Osman, N. N., & Basalamah, K. S. (2020). Role of gamma-irradiated basil (ocimum basilicum) in the alleviation of heart toxicity induced by arsenic in rats. International Journal of Pharmaceutical and Phytopharmacological Research (eIJPPR), 10(2), 101-109.
12. Singh, M.K., P.K. Singh, S.S. Yadav, U.S. Singh, P..Dwivedi, and R.S. Yadav, Attenuation of Arsenic-Induced Dyslipidemia by Fruit Extract of Emblica Officinalis in Mice. International Journal of Nutrition, Pharmacology, Neurological Diseases, 2018. 8(1): p.3-9.
13. Gökçe, Y., Kanmaz, H. İ. L. A. L., Er, B., Sahin, K., & Hayaloglu, A. A. (2021). Influence of purple basil (Ocimum basilicum L.) extract and essential oil on hyperlipidemia and oxidative stress in rats fed high-cholesterol diet. Food Bioscience, 43, 101228.
14. Hicham, H., Mohammed, A., & Souliman, A. (2009). Sweet basil (Ocimum basilicum L.) improves lipid metabolism in hypercholesterolemic rats J. Clinic. Nutr. Metab, 4, 181-186.
15. Umar, I. A., Mohammed, A., Dawud, F. A., Kabir, A. M., Sai, J. V., Muhammad, F. S., & Okalor, M. E. (2012). The hypolipidemic and antioxidant actions of aqueous extracts of Ocimum basilicum and Ocimum suave in high fat fed Rats. J Med Plants Res, 6(18): 3501-3505.
16. Purushothaman, B., PrasannaSrinivasan, R., Suganthi, P., Ranganathan, B., Gimbun, J., & Shanmugam, K. (2018). A comprehensive review on Ocimum basilicum. Journal of Natural Remedies, 18(3): 71-85.
17. Rasekh, H. R., Hosseinzadeh, L., Mehri, S., Kamli-Nejad, M., Aslani, M., & Tanbakoosazan, F. (2012). Safety assessment of Ocimum basilicum hydroalcoholic extract in wistar rats: acute and subchronic toxicity studies. Iranian journal of basic medical sciences, 15(1): 645.
18. Amrani, S., Harnafi, H., Bouanani, N. E. H., Aziz, M., Caid, H. S., Manfredini, S., ... & Bravo, E. (2006). Hypolipidaemic activity of aqueous ocimum basilicum extract in acute hyperlipidaemia induced by triton WR-1339 in rats and its antioxidant property. Phytotherapy Research: An International Journal Devoted to Pharmacological and Toxicological Evaluation of Natural Product Derivatives, 20(12), 1040-1045.
19. Goldstein, J.L. and M.S. Brown (2015). A century of cholesterol and coronaries: from plaques to genes to statins. Cell, 161(1):161-172.
20. You, C., P. Su, and X. Zhou (2008). Study on effect and mechanism of Scutellaria baicalensis stem-leaf total flavonoid in regulating lipid metabolism. China journal of Chinese Materia Medica, 33(9):1064-1066.
21. Shinde, S., N. Chivate, P. Kulkarni, and N. Naikwade (2013). Hypolipidemic activity of psidium guajava linn leaves extracts in hyperlipidemic rats. International Journal of Pharmacy and Pharmaceutical Sciences,5(1):70-72.
22. Sellers, R. S., Mortan, D., Michael, B., Roome, N., Johnson, J. K., Yano, B. L., ... & Schafer, K. (2007). Society of Toxicologic Pathology position paper: organ weight recommendations for toxicology studies. Toxicologic pathology, 35(5): 751-755.
23. Jeba, R. C., Vaidyanathan, R. A. M. A., & Rameshkumar, G. (2011). Efficacy of Ocimum basilicum for immunomodulatory activity in Wistar albino rat. International journal of pharmacy and phamaceutical Sciences, 3, 199-203.

*Address for correspondence
Dr. Victor Zigabelbari Zabbey
Department of Human Physiology, Faculty of Basic Medical Sciences, College of Health Science, University of Port Harcourt, Rivers State, Nigeria.
E-mail: zabbeyvictor@gmail.com

Ojeka, Sunday Ogbu; Onungwe, Belinda Chinwendu; Zabbey, Victor Zigabelbari: and Onwoke, Ebibi Elizah, "Modulatory Effects of Aqueous Leaf Extract of Ocimum basilicum on the Lipid Profiles and Body Weight of Male Wistar Rats, Exposed to Sodium Arsenite," *International Research Journal of Pharmacy and Medical Sciences (IRJPMS)*, Volume 7, Issue 2, pp. 24-28, 2024.