Trop J Nat Prod Res, June 2023; 7(6):3140-3146 ISSN 2616-0684 (Print)
ISSN 2616-0692 (Electronic)

Tropical Journal of Natural Product Research

Available online at https://www.tjnpr.org

Original Research Article

The Effects of Methotrexate, *Moringa oleifera* Leaf Extract, and *Andrographis paniculata* Leaf Extract on the Testes of Hyperglycemic Wistar Rats

Muhammad H.F. Nasution[1,2], Viskasari P. Kalanjati[3]*, Abdurachman Abdurachman[3], Dwi M. N. Aditya[1,4], Dimas B. B. Pamungkas[1,5], Maya R. Syamhadi[1,5]

[1]*Master's Study Program Basic Medical Sciences in Anatomy and Histology, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia*
[2]*Department of Anatomy, Faculty of Medicine, Universitas Malikussaleh, Aceh, Indonesia*
[3]*Department of Anatomy, Histology, and Pharmacology, Faculty of Medicine, Universitas Airlangga, Surabaya, Indonesia*
[4]*Department of Anatomy and Histology, Faculty of Medicine, Universitas Surabaya, Indonesia*
[5]*Department of Anatomy, Faculty of Medicine, Universitas Muhammadiyah Surabaya, Indonesia*

ARTICLE INFO

Article history:
Received 06 April 2023
Revised 20 June 2023
Accepted 23 June 2023
Published online 01 July 2023

ABSTRACT

It has been reported that MTX can lower blood glucose levels in type 1 diabetes mellitus (T1DM), while MO and AP can lower blood glucose levels in hyperglycemia. This study investigates the effects of administering MTX, MO leaf extract, AP leaf extract, and their combinations on the testicular tissue of diabetic rats. A total of 49 male Wistar rats were divided into seven groups, namely control (K1), STZ-NA (K2), STZ-NA+MO (K3), STZ-NA+AP (K4), STZ-NA+MTX (K5), STZ-NA+MTX+MO (K6), and STZ-NA+MTX+AP (K7). Out of 49 Wistar rats, 42 Wistar rats were intraperitoneally injected with streptozotocin and nicotinamide with a dose of 50 mg/kg and 110 mg/kg respectively. MTX was administered once a week (7 mg/kg), while MO and AP leaf extracts were given every day (500 mg/kg) for 28 days. Blood glucose levels were tested using a glucometer and body weight was measured using an Ohaus Triple Beam balance. Meanwhile, IL-6 levels in the testes were measured using ELISA. Testicular tissue was collected and analysed for histology using hematoxylin and eosin (H&E) staining. The results revealed a significant decrease in body weight in all STZ-NA-induced groups. In addition, the results revealed a significant increase in blood glucose levels in all STZ-NA-induced group. On the other hand, the administration of MO, AP, MTX, and their combinations significantly reduced the expression of IL-6 in the testicular tissue of diabetic rats. Therefore, it can be concluded that the administration of MO and AP can mitigate the adverse effects of hyperglycemia on the testicular tissue.

Keywords: Diabetes mellitus, methotrexate, *Moringa oleifera*, *Andrographis paniculata*, testes

Introduction

Hyperglycemia in patients with type 1 diabetes mellitus (T1DM) and type 2 diabetes mellitus (T2DM) has adverse effects, one of which is male infertility due to testicular inflammatory pathways.[1] The incidence of T1DM in children and adolescents and T2DM in patients aged under 40 increases the risk of prolonged exposure to hyperglycemia and subsequent long-term complications.[2] The prevalence of diabetes mellitus in men of childbearing age has been reported to increase and will continue to rise until 2045.[3] This increase in prevalence is closely linked to infertility rates in men.[4] Infertility can cause significant financial loss and emotional distress, affecting approximately 49 to 72 million people worldwide, or one in seven people. In 50% of childless couples, abnormal sperm is a factor in male infertility.[5]

One of the reported developments of methotrexate (MTX) as a potential antihyperglycemic agent is that low doses of MTX can lower blood glucose levels in rheumatoid patients with diabetes mellitus.[6]

*Corresponding author. E mail: viskasari-p-k@fk.unair.ac.id
Tel: +6231 5020251

Citation: Nasution MHF, Kalanjati VP, Abdurachman A, Aditya DMN, Pamungkas DBB, Syamhadi MR. The Effects of Methotrexate, *Moringa oleifera* Leaf Extract, and *Andrographis paniculata* Leaf Extract on the Testes of Hyperglycemic Wistar Rats. Trop J Nat Prod Res. 2023; 7(6): 3140-3146 http://www.doi.org/10.26538/tjnpr/v7i6.12

Official Journal of Natural Product Research Group, Faculty of Pharmacy, University of Benin, Benin City, Nigeria.

MTX has the potential to stimulate 5-aminoimidazole-4-carboxamide ribonucleotide (AICAR), activate AMP-activated protein kinase (AMPK), and regulate glucose uptake, and promote lipid oxidation in skeletal muscle.

Pharmacological activation of AMPK in skeletal muscle plays a role in enhancing glucose uptake without insulin mediation. As a result, it is very beneficial for patients with T1DM.[6] *Moringa oleifera* (MO) and *Andrographis paniculata* (AP) leaf extracts have been reported to be very beneficial for diabetes mellitus patients in terms of controlling blood sugar levels.[7–9] Previous studies have reported that MO and AP leaf extracts reduce the negative effects of chronic hyperglycemia on various tissues.[10,11] In addition, it has been reported that the potential anti-inflammatory effects of MO and AP leaf extracts is due to the suppression activity of the nuclear factor kappa-light-chain-enhancer of activated B cells (NF-kB) pathway.[12–15]

This study investigates the potential antihyperglycemic and anti-inflammatory effects of MTX, MO, and AP on the testes of male rodents with STZ-NA-induced hyperglycemia. We examined the individual and combined effects of these agents on the interleukin-6 (IL-6) levels in testicular tissue, number of Leydig cells, diameter and epithelial thickness of seminiferous tubules, and Johnsen score.[16–18]

Materials and Methods

Drugs and chemicals

This study used the following materials: streptozotocin (STZ) made in the United States by BioWorld with a batch number 41910012-2, nicotinamide (NA) made in India by Jubilant Ingrevia with a batch number B-2208-NIA049, methotrexate made in Indonesia by PT Kalbe

Farma (6°10'06.2"S 106°52'20.8"E) with a batch number TRHTA80001, *Moringa oleifera* leaf extract made in Indonesia by PT Sido Muncul (7°19'48.7"S 112°45'30.1"E) with a batch number EH00012, *Andrographis paniculata* leaf extract made in Indonesia by PT Jamu Iboe Jaya (7°22'19.1"S 112°38'40.7"E) with a batch number SB1081A, and IL-6 kit made in Indonesia by Bioenzy with a catalog number BZ- 08185310-EB.

Animal preparation
A total of 49 male Wistar rats aged between two and three months and weighing between 150 and 250 grams were acclimatized prior to the experiment. They were provided with *ad libitum* standard rodent diet (Pokphand CP 593, PT Charoen Pokphand, Indonesia) and drinking water during the experiment. The experimental protocol was approved by the Ethics Committee of the Faculty of Medicine, Universitas Airlangga with a certificate of ethical approval number No.1/EC/KEPK/FKUA/2022.

Induction of diabetes with streptozotocin and nicotinamide
Streptozotocin (50 mg/kg) and nicotinamide (110 mg/kg) dissolved in citrate buffer (pH 4.5) was injected intraperitoneally to induce diabetes. The injection of NA was administered 15 minutes earlier than the injection of STZ. One or two drops of blood from the lateral vein of the rats were used to test their blood glucose levels 72 hours after the administration of SN-NA using a glucometer.[19]

Animal experimental design
The animals were acclimatized for seven days prior to the experiment (n = 49). All animals were randomly divided into K1, K2, K3, K4, K5, K6, and K7 groups which consisted of seven rats per group. Animals in group 1 (K1) served as the control group and were not induced with STZ-NA. Meanwhile, the other animals with blood glucose levels of 250 mg/dl and above were assigned into K2, K3, K4, K5, K6, and K7 groups. On the third day following the injection of STZ-NA, treatments with MTX, MO, AP, and their combinations were given. Animals in K3 group were given *Moringa oleifera* leaf extract with a daily dose of 500 mg/kgBW for 28 days (STZ-NA+MO). Animals in K4 group were given *Andrographis paniculata* leaf extract with a daily dose of 500 mg/kgBW for 28 days (STZ-NA+AP). Animals in K5 group were given methotrexate with a daily dose of 7 mg/kgBW for 28 days (STZ-NA+MTX) . Animals in K6 group were given methotrexate with a daily dose of 7 mg/kgBW and *Moringa oleifera* leaf extract with a daily dose of 500 mg/kgBW for 28 days (STZ-NA+MTX+MO). Animals in K7 group were given methotrexate with a daily dose of 7 mg/kgBW and *Andrographis paniculata* leaf extract with a daily dose of 500 mg/kgBW for 28 days (STZ-NA+MTX+AP). The administered dose of methotrexate was based on a previous study by Koyama et al.[20] The administration of *Moringa oleifera* leaf extract was based on a previous study by Jamil et al.[21] The administration of *Andrographis paniculata* leaf extract was based on a previous study by Ogunlana et al.[18] The animals were euthanized using an overdose of ether inhalation and decapitation following the end of experiment. Finally, the samples were collected for analysis.

Measurement of body weight
Body weight was measured on the day of the injection of STZ-NA and the third of the experiment (day 24) using an Ohaus Triple Beam balance (Shimadzu, Japan).

Measurement of blood glucose level
Blood glucose levels were measured following the injection of STZ-NA and prior to any treatments (day 3 and day 15) using an EasyTouch Glucometer type ET-301F made in Taiwan with a batch number 301F2C007837.

Measurement of testicular IL-6 expression
The IL-6 levels of the right testes was measured using the ELISA technique (day 29).[22]

Histological preparations
On day 29, the left testes of the animals were collected and histologically processed. The histology process began with immersing the testes in a fixative solution, namely 10% buffered formalin. Following fixation were dehydration and embedding. The dehydration used ethanol, while the embedding used paraffin wax to make it easy for cellular extraction. The paraffin block containing the left testis then sliced into 5 µm sections and stained with hematoxylin-eosin. The histological analysis were performed using a light microscope (Olympus CX23, Olympus Corporation, Japan) with an objective magnification of 400x in 20 visual fields. Subsequently, images from 20 seminiferous tubules were processed using analytical software, namely Olympus cellSens (RRID: SCR_014551) and ImageJ.[23,24]

Testicular histopathological evaluation
Testicular histopathology was evaluated in terms of four measurements: average diameter, epithelium thickness, number of Leydig cells, and Johnsen score of 20 seminiferous tubules in each experimental animal. The diameter of the seminiferous tubules was measured by calculating the average diameter of the longest and shortest seminiferous tubules. The epithelium thickness of the seminiferous tubules was measured by calculating the average of four measurements at 90˚, 180˚, 270˚, and 360˚ angles.[23] The Johnsen score criteria provided a quantitative evaluation elements of the seed and the relationship between spermatogenesis and the density of spermatozoa in the seminal fluid.[25]

Statistical analysis
The data were analyzed using SPSS 17.0.[26] Prior to making statistical comparisons, the Shapiro-Wilk test for normality and Levene's test for homogeneity. Body weight, random blood glucose levels, IL-6 levels in the testes, number of Leydig cells, diameter of seminiferous tubules, epithelium thickness of seminiferous tubules, and Johnsen score of the seven groups were compared with significance level of $p < 0.05$. A post-hoc test for Kruskal-Wallis was performed with Mann-Whitney post-test, while one-way ANOVA was performed with Fisher's LSD post-test.

Results and Discussion

The results of this study revealed dynamic changes in the body weight from the beginning of the experiment to day 24, as shown in Table 1. It was found that the body weight of the animals in BW1 did not show any significant differences among all groups ($p = 0.716$). However, after 24 days of experiment, the body weight of the animals in K2, K3, K4, K5, K6, and K7 groups decreased. Therefore, the body weight of the animals in BW2 showed significant differences ($p < 0.001$).
Previous studies have demonstrated significant weight loss in diabetic experimental animals induced with streptozotocin.[27,28] This weight loss is associated with reduced insulin levels, leading to protein degradation for amino acid provision and subsequent gluconeogenesis which can result in muscle mass reduction and weight loss in animals injected with STZ.[29] Several studies have shown that the administration of MO and AP leaf extracts can prevent weight loss in diabetic rats induced with STZ and STZ-NA.[7,29–32] MO leaf extract containing antioxidants and antimicrobial compounds (e.g., phenols, tannins, alkaloids, and coumarins) acts as a growth promoter and inhibits lipase activity, which reduces lipolysis and hepatic conversion of fatty acids to cholesterol.[31,32] Meanwhile, AP leaf extract increases plasma protein levels, thereby preventing weight loss associated with excessive protein breakdown.[8] Furthermore, it has been reported that the administration of MTX in rheumatoid arthritis patients resulted in weight gain.[33] This is probably due to the accumulation of AICAR upon the administration of MTX, which inhibits fructose-1,6-bisphosphatase, a key enzyme in gluconeogenesis, and increases GLUT4 translocation enhancing glucose uptake by insulin target cells.[34] Throughout the study, dynamic changes in blood glucose levels were observed. Table 2 presents the descriptively data on blood glucose levels in the experimental animals. BG1 showed a significant difference among all groups ($p = 0.006$). BG2 also showed a significant difference among all groups ($p < 0.001$). When comparing BG1 to BG2, a downward trend was observed in K3,

K4, K5, K6, and K7 groups. An increase was observed in K2 group, K1 group showed relatively no change.

The administration of MO and AP leaf extracts in previous studies has been reported to significantly reduce blood glucose level.[7,8,35,36] Quercetin in MO extract effectively increases glucokinase activity in the liver like insulin. MO leaf also contains terpenoids, which stimulates cells and promote insulin secretion. Other compounds found in MO leaf, such as isothiocyanates, reduce insulin resistance and hepatic gluconeogenesis.[10,11] On the other hand, the andrographolide compound in AP extract has been reported to enhance glucose utilization by increasing GLUT-4 mRNA and protein levels.[37] The administration of MTX can significantly lower blood glucose levels due to its inhibitory effect on the AICAR transformylase. This triggers intracellular AICAR accumulation and results in an increase in GLUT4 expression and translocation as well as inhibition of fructose-1,6-bisphosphatase as a key enzyme in gluconeogenesis. This further reduces blood glucose levels and insulin concentrations. In addition, MTX involved in the pathogenesis of diabetes mellitus has been reported to suppress the NF-kB pathway.[34,38]

The IL-6 levels in the left testicular tissue for each group are presented in Table 3. A significant difference in the IL-6 levels in testicular tissue was observed among all groups ($p = 0.002$). A significant increase of IL-6 levels was observed in K1 and K2 groups ($p < 0.001$). The IL-6 levels in K3, K4, K5, K6, and K7 groups were significantly lower than K2 group ($p = 0.006$, $p = 0.002$, $p = 0.021$, $p = 0.001$, $p < 0.001$, respectively).

These results are consistent with previous studies which demonstrated an increase in the expression of IL-6 in testicular tissue of diabetes mellitus rats.[39] This is probably due to the activation of inflammatory pathway mediated by NF-kB.[40]

Table 1: Average body weight (gr) of rats

	Groups	BW1 (Mean ± SD)	BW2 (Mean ± SD)
1	K1	244 ± 22.2	314 ± 7.9
2	K2	252 ± 23.0	134 ± 2.4
3	K3	245 ± 29.2	235 ± 28.0
4	K4	248 ± 22.1	239 ± 91.9
5	K5	231 ± 16.1	218 ± 39.0
6	K6	242 ± 21.0	222 ± 37.3
7	K7	241 ±18.4	213 ± 84.9
	p-value	0.716[a]	<0.001[b]

[a]Significant at $p < 0,05$ (ANOVA)
[b]Significant at $p < 0,05$ (Kruskal-Wallis)
BW1 = BW on the day of STZ-NA injection
BW2 = BW after 24 days of MTX, MO, and AP administration

Table 2: Average blood glucose levels (mg/dL)

	Groups	BG1 (Mean ± SD)	BG2 (Mean ± SD)
1	K1	107 ± 9.0	104 ± 11.6
2	K2	565 ± 47.4	597 ± 4.9
3	K3	465 ± 90.9	372 ± 88.6
4	K4	490 ± 121.6	364 ± 47.9
5	K5	451 ± 110.0	394 ± 64.3
6	K6	407 ± 109.0	343 ± 182.1
7	K7	444 ± 51.8	334 ± 154.0
	p-value	0.006*	<0.001*

*Significance with $p<0.05$ (Kruskal-Wallis)
BG1 = BG after 3 days of STZ-NA injection
BG2 = BG after 15 days of MTX, MO, and AP administration

Table 3: Testicular IL-6 (ng / L) expression levels in K1-K7 groups

	Groups	Mean ± SD	p-value
1	K1	10.40 ± 1.40	
2	K2	12.8 ± 1.30	
3	K3	11.23 ± 1.19	
4	K4	11.04 ± 0.53	0.002
5	K5	11.53 ± 0.82	
6	K6	10.73 ± 0.37	
7	K7	10.54 ± 0.62	

*Significant at $p < 0.05$ (one way-ANOVA)

Previous studies have reported that MO extract has the ability to decrease the IL-6 levels in the plasma and also reduce the IL-6 expression in the kidneys.[16,41,42] Other studies have also reported that AP extract has the ability to reduce the IL-6 levels in the testes.[43] In addition, MTX has been shown to decrease the IL-6 levels in the blood and reduce the IL-6 expression in the synoviocytes.[44,45] These effects may be associated with the activity of the NF-kB pathway, which can be suppressed by MO extract, AP extract, and MTX, thereby reducing the IL-6 expression.[12,14,15,46]

Histopathology of the testes was evaluated in terms of four measurements: (1) the average number of Leydig cells analyzed using one way-ANOVA test; (2) the average diameter of seminiferous tubules analyzed using the Kruskal-Wallis test; (3) the average epithelial thickness of seminiferous tubules analyzed using the Kruskal-Wallis test; (4) the Johnsen score analyzed using the Kruskal-Wallis test (Figure 1). The number of Leydig cells in K2 group was significantly lower than in K1 group ($p < 0.001$), while in K3, K4, K6, and K7 groups were significantly higher than in K2 group ($p < 0.001$, $p = 0.001$, $p = 0.001$, $p < 0.001$, respectively). The diameter of seminiferous tubules in K2 group was significantly smaller than in K1 group ($p = 0.003$), while in K4 and K7 groups were significantly higher than in K2 group ($p = 0.022$ and $p = 0.01$, respectively). The epithelial thickness of seminiferous tubules in K2 group was significantly thinner than in K1 group ($p = 0.004$), while in K3, K4, K6, and K7 groups were significantly thicker than in K2 group ($p = 0.025$, $p = 0.015$, $p = 0.022$, $p = 0.007$, respectively). The Johnsen score in K2 group was significantly lower than in K1 group ($p = 0.002$), while in K3, K4, K6, and K7 were significantly higher than in K2 group ($p = 0.010$, $p = 0.003$, $p = 0.038$, $p = 0.003$, respectively). These results are consistent with previous studies which demonstrated a decrease in the average number of Leydig cells, diameter and epithelium thickness of seminiferous tubules, and Johnsen score in the testes of diabetes mellitus rats.[47–53] Diabetes mellitus causes hyperglycemia, which can increase reactive oxygen species (ROS) in all organs. Furthermore, oxidative stress caused by increased ROS can reduce luteinizing hormone (LH) secretion, which stimulates the growth of Leydig cells.[54] Other studies have reported that diabetes-induced oxidative stress can decrease antioxidant enzyme levels in Leydig cells, which can result in reduced testosterone synthesis. Low testosterone levels cause dysfunction of spermatogenesis, which can interfere with cell proliferation.[55] In addition, the inflammatory activity in diabetes mellitus can increase the IL-6 levels, which can affect the number and function of Leydig cells.[40,56,57] IL-6 as an inflammatory cytokine has been reported to participate in spermatogenesis.[13,58] Previous studies have shown that IL-6 deficiency increases daily sperm production, spermatid count, as well as testosterone and dihydrotestosterone levels.[59] IL-6 can also affect p-ERK1/2 expression in Sertoli cells and disrupt the ERK-MAPK pathway, leading to impaired permeability of the blood-testis barrier (BTB) in Sertoli cells, compromising the integrity of Sertoli cells and ultimately affecting spermatogenesis.[13] Both the hormone and IL-6 expression pathway can disrupt the structure of seminiferous tubules, in terms of diameter and epithelium thickness, and the Johnsen Score, which indicates histopathological failure of spermatogenesis in diabetic rats. This is due to germ cell proliferation that plays a role in the growth

of the seminiferous tubules, both in diameter and thickness.[60,61] These findings are supported by the results of this study, which demonstrated a decrease in the number of Leydig cells and an increase in the IL-6 expression in the STZ-NA group (K2) compared to the control group (K1). Furthermore, the results of histopathological evaluation in K3, K4, K5, K6, and K7 groups were consistent with previous studies which demonstrated a significant increase in the number of Leydig cells, epithelium thickness of the seminiferous tubules, and Johnsen score, following the administration of MO or AP.[62–65] Both MO and AP extracts contain antioxidant and antihyperglycemic agents which can reduce oxidative stress and increase testosterone production in experimental animals.[10,66–69] In addition, MO extract has been reported to have anti-inflammatory properties which can reduce the IL-6 levels in the plasma, while AP extract can reduce the IL-6 expression in the testes.[16,43]

The group that received MTX therapy (K5) did not show a significant increase in the four testicular histopathological evaluations when compared to the STZ-NA group (K2) ($p > 0.05$). Low doses of MTX as an anti-inflammatory agent suppress the activity of NF-kB pathway and block gene transcription mediated by NF-kB and IL-6. This decrease in IL-6 expression will increase spermatogenesis.[13,46] However, it should be noted that the results of this study are slightly different from previous studies, where MTX can cause seminiferous tubule atrophy and significantly reduce the Johnsen score in experimental animals when compared to experimental animals that did not receive MTX.[70,71] In addition, MTX can increase ROS and decrease LH secretion, which in turn will decrease the number of Leydig cells and interfere with spermatogenesis.[72] Because of these opposing effects, MTX has not been able to significantly improve testicular histopathology.

Conclusion

The administration of MTX, MO, or AP led to a decrease in the body weight and an increase in blood glucose levels and IL-6 levels in STZ-NA-hyperglycemic-induced rats. MO or AP extracts have been shown to increase the average number of Leydig cells as well as the diameter and epithelial thickness of the seminiferous tubules. Meanwhile, histological evaluations of the testes showed higher Johnsen score in the treated animals. In conclusion, administering MO and AP leaf extracts may prevent infertility complications in diabetic rats.

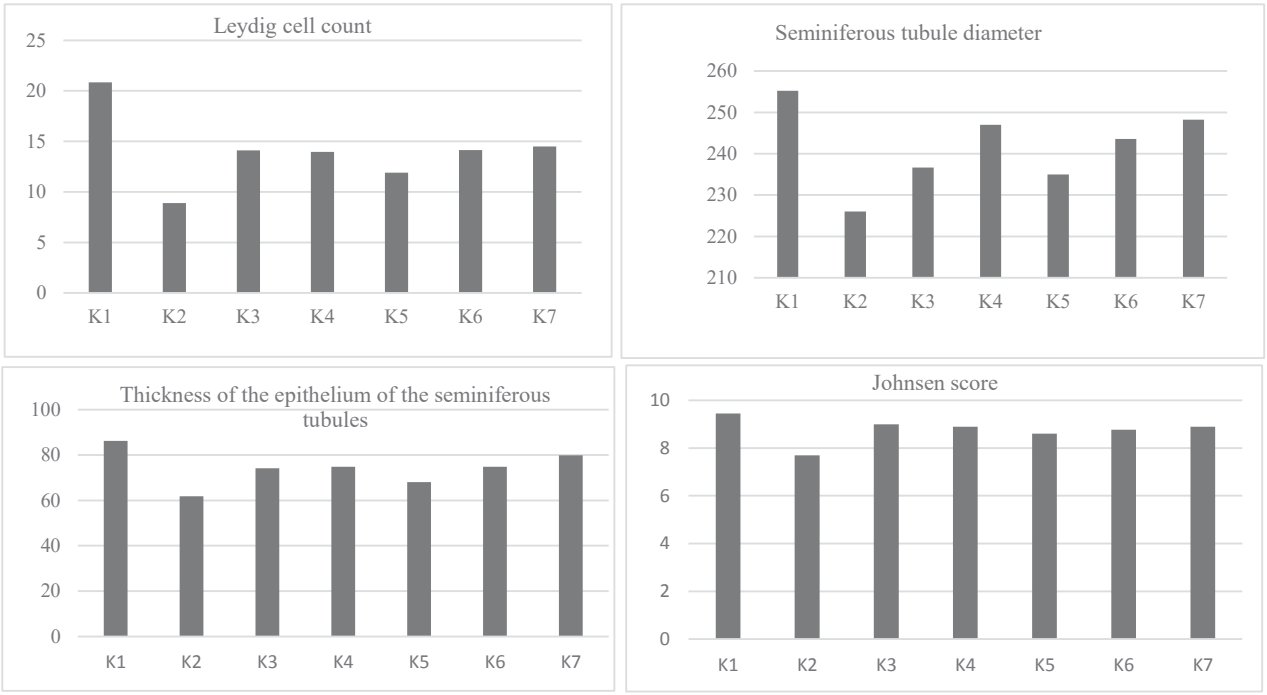


Figure 1: Results of testicular histopathological evaluation of K1-K7 (observed under 400x magnification of light microscope [Olympus, Japan]).

Conflict of Interest

The authors declare no conflict of interest.

Authors' Declaration

The authors hereby declare that the work presented in this article is original and that any liability for claims regading the content of this article will be borne by them.

Acknowledgements

The authors are grateful to the Faculty of Medicine, Universitas Airlangga, Indonesia and Faculty of Medicine, Malikussaleh University, Aceh for the support.

References

1. Nna VU, Bakar ABA, Ahmad A, Mohamed M. Diabetes-induced testicular oxidative stress, inflammation, and caspase-dependent apoptosis: the protective role of metformin. Arch Physiol Biochem. 2020; 126(5): 377-388. doi:10.1080/13813455.2018.1543329
2. Lascar N, Brown J, Pattison H, Barnett AH, Bailey CJ, Bellary S. Type 2 diabetes in adolescents and young adults. Lancet Diabetes Endocrinol. 2018; 6(1): 69-80. doi:10.1016/S2213-8587(17)30186-9d
3. Sun H, Saeedi P, Karuranga S, Pinkepank M, Ogurtsova K, Duncan BB, Stein C, Basit A, Chan JCN, Mbanya JC, Pavkov ME, Ramachandaran A, Wild SH, James S, Herman WH, Zhang P, Bommer C, Kuo S, Boyko EJ, Magliano DJ. IDF Diabetes Atlas: Global, regional and country-level

diabetes prevalence estimates for 2021 and projections for 2045. Diabetes Res Clin Pract. 2022; 183: 1-13. doi:10.1016/j.diabres.2021.109119
4. He Z, Yin G, Li QQ, Zeng Q, Duan J. Diabetes mellitus causes male reproductive dysfunction: A review of the evidence and mechanisms. In Vivo (Brooklyn). 2021; 35(5): 2503-2511. doi:10.21873/INVIVO.12531
5. Öztekin Ü, Caniklioğlu M, Sarı S, Selmi V, Gürel A, Işıkay L. Evaluation of male infertility prevalence with clinical outcomes in middle anatolian region. Cureus. 2019; 11(7): 1-6. doi:10.7759/cureus.5122
6. Pirkmajer S, Kulkarni SS, Tom RZ, Ross FA, Hawley SA, Hardie DG, Zierath JR, Chibalin AV. Methotrexate promotes glucose uptake and lipid oxidation in skeletal muscle via AMPK activation. Diabetes. 2015; 64(2): 360-369. doi:10.2337/db14-0508
7. Verma VK, Kumar Sarwa K, Zaman MK. Antihyperglycemic activity of *Swertia chirayita* and *Andrographis paniculata* plant extracts in streptozotocin-induced diabetic rats. Int J Pharm Pharm Sci. 2013; 5(3): 305-311.
8. Sivakumar V, Rajeshkumar S. Protective effect of *Andrographis paniculata* on hyperglycemic mediated oxidative damage in renal tissues of diabetic rats. J Phytopharm. 2016; 4(6): 287-294.
9. Okhuarobo A, Ehizogie Falodun J, Erharuyi O, Imieje V, Falodun A, Langer P. Harnessing the medicinal properties of *Andrographis paniculata* for diseases and beyond: A review of its phytochemistry and pharmacology. Asian Pacific J Trop Dis. 2014; 4(3): 213-222. doi:10.1016/S2222-1808(14)60509-0
10. Bamagous GA, Al Ghamdi SS, Ibrahim IAA, Mahfoz AM, Afify MA, Alsugoor MHM, Shammah AA, Arulselvan P, Rengarajan T. Antidiabetic and antioxidant activity of ethyl acetate extract fraction of *Moringa oleifera* leaves in streptozotocin-induced diabetes rats via inhibition of inflammatory mediators. Asian Pac J Trop Biomed. 2018; 8(6): 320-327. doi:10.4103/2221-1691.235327
11. Fatoumata B, MamadouSaïdou B, Mohamet S, Joseph KS, Modou MG, El HB. Antidiabetic properties of *Moringa oleifera*: A review of the literature. J Diabetes Endocrinol. 2020; 11(1): 18-29. doi:10.5897/jde2019.0136
12. Berkovich L, Earon G, Ron I, Rimmon A, Vexler A, Lev-Ari S. *Moringa Oleifera* aqueous leaf extract down-regulates nuclear factor-kappaB and increases cytotoxic effect of chemotherapy in pancreatic cancer cells. BMC Complement Altern Med. 2013; 13(212): 1-7. doi:10.1186/1472-6882-13-212
13. Zhang H, Yin Y, Wang G, Liu Z, Liu L, Sun F. Interleukin-6 disrupts blood-testis barrier through inhibiting protein degradation or activating phosphorylated ERK in Sertoli cells. Sci Rep. 2014; 4: 1-7. doi:10.1038/srep04260
14. Kim M-Y. NF-κB and MAPK-Targeted Anti-inflammatory activity of *Andrographis Paniculata* extract. Am J Biomed Sci Res. 2021; 11(5): 452-458.
15. Sailaja BS, Aita R, Maledatu S, Ribnicky D, Verzi MP, Raskin I. Moringa isothiocyanate-1 regulates Nrf2 and NF-κB pathway in response to LPS-driven sepsis and inflammation. PLoS One. 2021; 16(4 April): 1-18. doi:10.1371/journal.pone.0248691
16. Cuellar-Núñez ML, Gonzalez de Mejia E, Loarca-Piña G. *Moringa oleifera* leaves alleviated inflammation through downregulation of IL-2, IL-6, and TNF-α in a colitis-associated colorectal cancer model. Food Res Int. 2021; 144: 1-13. doi:10.1016/j.foodres.2021.110318
17. Baghdadi LR. Effect of methotrexate use on the development of type 2 diabetes in rheumatoid arthritis patients: A systematic review and meta-analysis. PLoS One. 2020; 15(7): 1-22. doi:10.1371/journal.pone.0235637
18. Ogunlana OO, Adetuyi BO, Esalomi EF, Rotimi MI, Popoola JO, Ogunlana OE, Adetuyi OA. Antidiabetic and antioxidant activities of the twigs of *Andrograhis paniculata* on streptozotocin-induced diabetic male rats. BioChem. 2021; 1(3):238-249.
19. Szkudelski T. Streptozotocin-nicotinamide-induced diabetes in the rat. Characteristics of the experimental model. Exp Biol Med. 2012; 237(5):481-490.
20. Koyama A, Tanaka A, To H. Daily oral administration of low-dose methotrexate has greater antirheumatic effects in collagen-induced arthritis rats. J Pharm Pharmacol. 2017; 69(9): 1145-1154. doi:10.1111/jphp.12752
21. Jamil A, Khan I, Blundell R. *Moringa oleifera* and glycemic control : A review of current evidence and possible mechanisms. Phyther Res. 2019; 1-8. doi:10.1002/ptr.6473
22. Rival C, Theas MS, Guazzone VA, Lustig L. Interleukin-6 and IL-6 receptor cell expression in testis of rats with autoimmune orchitis. J Reprod Immunol. 2006; 70(1-2): 43-58. doi:10.1016/j.jri.2005.10.006
23. Yalçin T, Kaya S, Kaya Tektemur N, Ozan İE. The methods used in histopathological evaluation of testis tissues. Batman Univ J Life Sci Batman Üniversitesi Yaşam Bilim Derg. 2020; 10(1): 148.
24. Schneider CA, Rasband WS, Eliceiri KW. NIH image to imagej: 25 years of image analysis. Nat Methods. 2012; 9(7): 671-675. doi:10.1038/nmeth.2089
25. Thanh TN, Van PD, Cong TD, Le Minh T, Vu QHN. Assessment of testis histopathological changes and spermatogenesis in male mice exposed to chronic scrotal heat stress. J Anim Behav Biometeorol. 2020; 8: 174-180. doi:10.31893/JABB.20023
26. Gouda MA. Common pitfalls in reporting the use of SPSS software. Med Princ Pract. 2015; 24(3): 300. doi:10.1159/000381953
27. Rias AY, Sutikno E. Hubungan antara berat badan dengan kadar gula darah acak pada tikus diabetes mellitus. J Wiyata. 2017; 4(1): 72-77.
28. Ali A, Shaheen S, Zahid N, Zafar U, Ahmad F, Farooq L. Effects of metformin on the weight of healthy and streptozotocin-induced diabetic animal model. J Ayub Med Coll Abbottabad. 2021; 33(4): 572-576.
29. Wediasari F, Nugroho GA, Fadhilah Z, Elya B, Setiawan H, Mozef T. Hypoglycemic effect of a combined *Andrographis paniculata* and *Caesalpinia sappan* extract in streptozocin-induced diabetic rats. Adv Pharmacol Pharm Sci. 2020; 2020. doi:10.1155/2020/8856129
30. Adedapo AA, Mogbojuri OM, Emikpe BO. Safety evaluations of the aqueous extract of the leaves of *Moringa oleifera* in rats. J Med Plants Res. 2009; 3(8): 586-591.
31. Villarruel-López A, López-de la Mora DA, Vázquez-Paulino OD, Puebla-Mora AG, Torres-Vitela MR, Guerrero-Quiroz LA, Nuno K. Effect of *Moringa oleifera* consumption on diabetic rats. BMC Complement Altern Med. 2018; 18(127): 1-10. doi:10.1186/s12906-018-2180-2
32. Olayaki LA, Irekpita JE, Yakubu MT, Ojo OO. Methanolic extract of *Moringa oleifera* leaves improves glucose tolerance, glycogen synthesis and lipid metabolism in alloxan-induced diabetic rats. J Basic Clin Physiol Pharmacol. 2015; 26(6): 585-593. doi:10.1515/jbcpp-2014-0129
33. Baker JF, Sauer BC, Cannon GW, Teng C, Michaud K, Ibrahim S, Jorgenson E, Davis L, Caplan L, Cannella A, Mikuls TR. Changes in body mass related to the initiation of disease-modifying therapies in rheumatoid arthritis. Arthritis Rheumatol. 2016; 68(8): 1818-1827. doi:10.1002/art.39647
34. Russo GT, Minutoli L, Bitto A, Altavilla D, Alessi E, Giandalia A, Romeo EL, Stagno MF, Squadrito F, Cucinotta D, Selhub J. Methotrexate increases skeletal muscle GLUT4 expression and improves metabolic control in experimental diabetes. J Nutr Metab. 2012; 2012:132056. doi:10.1155/2012/132056
35. Rakesh H, Mani SS, Basha PM. Chronic cold exposure aggravates oxidative stress in reproductive organs of stz-

induced diabetic rats: Protective role of *Moringa oleifera*. J Appl Biol Biotechnol. 2021; 9(3): 114-120. doi:10.7324/JABB.2021.9314
36. Kamalrudin A, Jasamai M, Noor MM. Ameliorative effect of *Moringa oleifera* fruit extract on reproductive parameters in diabetic-induced male rats. Pharmacogn J. 2018; 10(6): S54-S58. doi:10.5530/pj.2018.6s.10
37. Nugroho AE, Andrie M, Warditiani NK, Siswanto E, Pramono S, Lukitaningsih E. Antidiabetic and antihiperlipidemic effect of *Andrographis paniculata* (Burm. f.) nees and andrographolide in high-fructose-fat-fed rats. Indian J Pharmacol. 2012; 44(3): 377-381. doi:10.4103/0253-7613.96343
38. Donath MY, Shoelson SE. Type 2 diabetes as an inflammatory disease. Nat Rev Immunol. 2011; 11(2): 98-107. doi:10.1038/nri2925
39. Mourad M, Hanaa M, Khalaf M. Fenofibrate ameliorates testicular damage in rats with streptozotocin‐induced type 1 diabetes : role of HO‐1 and p38 MAPK. Pharmacol Reports. 2020; 72(6): 1645-1656. doi:10.1007/s43440-020-00096-0
40. Nna VU, Bakar ABA, Ahmad A, Eleazu CO, Mohamed M. Oxidative stress, NF-κB-mediated inflammation and apoptosis in the testes of streptozotocin–induced diabetic rats: Combined protective effects of malaysian propolis and metformin. Antioxidants. 2019; 8(10).
41. Famurewa AC, Asogwa NT, Aja PM, Akunna GG, Awoke JN, Ekeleme-Egedigwe CA, Maduagwuna EK, Folawiyo AM, Besong EE, Ekpono EU, Nwoha PA. *Moringa oleifera* seed oil modulates redox imbalance and iNOS/NF-κB/caspase-3 signaling pathway to exert antioxidant, anti-inflammatory and antiapoptotic mechanisms against anticancer drug 5-fluorouracil-induced nephrotoxicity in rats. South African J Bot. 2019; 127: 96-103. doi:10.1016/j.sajb.2019.08.038
42. Karthivashan G, Kura AU, Arulselvan P, Isa NM, Fakurazi S. The modulatory effect of *Moringa oleifera* leaf extract on endogenous antioxidant systems and inflammatory markers in an acetaminophen-induced nephrotoxic mice model. PeerJ. 2016; 4:e2127. doi:10.7717/peerj.2127
43. Ogundola AF, Akhigbe RE, Saka WA, Adeniyi AO, Adeshina OS, Babalola DO, Akhigbe TM. Contraceptive potential of *Andrographis paniculata* is via androgen suppression and not induction of oxidative stress in male Wistar rats. Tissue Cell. 2021; 73: 101632. doi:10.1016/j.tice.2021.101632
44. Aggarwal A, Misra R. Methotrexate inhibits interleukin-6 production in patients with juvenile rheumatoid arthritis. Rheumatol Int. 2003; 23(3): 134-137. doi:10.1007/s00296-002-0267-y
45. Sung JY, Hong JH, Kang HS, Choi I, Lim SD, Lee JK, Seok JH, Lee JH, Hur GM. Methotrexate suppresses the interleukin-6 induced generation of reactive oxygen species in the synoviocytes of rheumatoid arthritis. Immunopharmacology. 2000; 47(1): 35-44.
46. Majumdar S, Aggarwal BB. Methotrexate suppresses NF-κB activation through inhibition of IκBα phosphorylation and degradation. J Immunol. 2001; 167(5): 2911-2920. doi:10.4049/jimmunol.167.5.2911
47. Abbasi Z, Tabatabaei SRF, Mazaheri Y, Barati F, Morovvati H. Effects of sesame oil on the reproductive parameters of diabetes mellitus-induced male rats. World J Mens Health. 2013; 31(2): 141. doi:10.5534/wjmh.2013.31.2.141
48. Nah WH, Koh IK, Ahn HS, Kim MJ, Kang HG, Jun JH, Gye MC. Effect of *Spirulina maxima* on spermatogenesis and steroidogenesis in streptozotocin-induced type I diabetic male rats. Food Chem. 2012; 134(1): 173-179. doi:10.1016/j.foodchem.2012.02.085
49. Kotian SR, Kumar A, Mallik SB, Bhat NP, Souza AD, Pandey AK. Effect of diabetes on the Male reproductive system—A histomorphological study. J Morphol Sci. 2019; 36(1): 17-23. doi:10.1055/s-0039-1683405
50. Sisman AR, Kiray M, Camsari UM, Evren M, Ates M, Baykara B, Aksu I, Guvendi G, Uysal N. Potential novel biomarkers for diabetic testicular damage in streptozotocin-induced diabetic rats: Nerve growth factor beta and vascular endothelial growth factor. Dis Markers. 2014; 2014. doi:10.1155/2014/108106
51. Faddladdeen KAJ. The possible protective and therapeutic effects of *Ginger* and *Cinnamon* on the testis and coda epididymis of streptozotocin-induced-diabetic rats: Histological and biochemical studies. Saudi J Biol Sci. 2022; 29(12): 103452. doi:10.1016/j.sjbs.2022.103452
52. Rimbun, Purwantari KE, Sari DR, Yuliawati TH. Pengaruh Cholecalciferol terhadap tebal epitel tubulus seminiferous tikus dengan diabetes mellitus. Maj Biomorfologi. 2015; 28(1): 15-19.
53. Ghanbari E, Nejati V, Khazaei M. Antioxidant and protective effects of Royal jelly on histopathological changes in testis of diabetic rats. Int J Reprod Biomed. 2016; 14(8): 511-518. doi:10.29252/ijrm.14.8.519
54. Budiastuti B, Safitri YA, Plumeriastuti H, Srianto P, Effendi MH. Effect of *Cinnamon* (*Cinnamomum burmannii*) bark oil on testicular histopathology in streptozotocin induced diabetic wistar male rats. J Glob Pharma Technol. 2020; 12(2): 901-907.
55. Pourheydar B, Azarm F, Farjah G, Karimipour M, Pourheydar M. Effect of *Silymarin* and metformin on the sperm parameters and histopathological changes of testes in diabetic rats : An experimental study. 2021; 19(12): 1091-1104. doi.org/10.18502/ijrm.v19i12.10060
56. Wang Y, Chen L, Xie L, Li L, Li X, Li H, Liu J, Chen X, Mao B, Song T, Lian Q, Ge RS. Interleukin 6 inhibits the differentiation of rat stem Leydig cells. Mol Cell Endocrinol. 2018; 472: 26-39. doi:10.1016/j.mce.2017.11.016
57. Zhao LL, Makinde EA, Olatunji OJ. Protective effects of ethyl acetate extract from *Shorea roxburghii* against diabetes induced testicular damage in rats. Environ Toxicol. 2021; 36(3): 374-385. doi:10.1002/tox.23043
58. O'Bryan MK, Hedger MP. Inflammatory networks in the control of spermatogenesis: Chronic inflammation in an immunologically privileged tissue? Adv Exp Med Biol. 2008; 636: 92-114. doi:10.1007/978-0-387-09597-4_6
59. Alves-Silva T, Freitas GA, Húngaro TGR, Arruda AC, Oyama LM, Avellar MCW, Araujo RC. Interleukin-6 deficiency modulates testicular function by increasing the expression of suppressor of cytokine signaling 3 (SOCS3) in mice. Sci Rep. 2021; 11(1): 1-9. doi:10.1038/s41598-021-90872-6
60. Franca LR, Silva VA, Chiarini-Garcia H, Garcia SK, Dabeljuk L. Cell proliferation and hormonal changes during postnatal development of the testis in the pig. Biol Reprod. 2000; 63(6): 1629-1636.
61. Omar SS, Aly RG, Badae NM. Vitamin E improves testicular damage in streptozocin-induced diabetic rats , via increasing vascular endothelial growth factor and poly (ADP--ribose) polymerase-1. Andrologia. 2017; 50(3): 1-8.
62. Hanafi A, Fadholly A, Utomo B, Sudjarwo SA, Yunus M, Hariadi M, Legowo D. Effects of *Moringa oleifera* l. Extract on leydig and sertoli cells induced high temperature on rattus norvegicus. Res J Pharm Technol. 2020; 13(7): 3361-3364. doi:10.5958/0974-360X.2020.00597.1
63. Prabsattroo T, Wattanathorn J, Iamsaard S, Somsapt P, Sritragool O, Thukhumme W, Muchimapura S. *Moringa oleifera* extract enhances sexual performance in stressed rats. J Zhejiang Univ Sci B. 2015; 16(3): 179-190.
64. Mardatillah M, Wurlina W, Yudaniayanti IS, Primarizky H, Plumeriastuti H, Hamid IS. *Moringa oleifera* leaf extract restored the diameter and epithelium thickness of the seminiferous tubules of rat (Rattus norvegicus) injected with

gentamicin. Ovozoa J Anim Reprod. 2022; 11(1): 15-21. doi:10.20473/ovz.v11i1.2022.15-21
65. Proboningrat A, Plumeriastuti H, Utama S, Sudjarwo SA, Legowo D, Luqman EM, Widjiati. Effect of *Moringa oleifera* leaf extract on the histopathological features of testicular seminiferoustubules of mice (mus musculus) exposed to methylmercury. Ecol Environ Conserv. 2022; 28(1): 233-237. doi:10.53550/eec.2022.v28i01.031
66. Bashah NAK, Noor MM. Antihyperglycemic and androgenic properties of *Moringa oleifera* leaves aqueous extract attenuate sexual dysfunction in diabetes-induced male rats. Malaysian Appl Biol. 2021; 50(2 Special Issue): 99-105.
67. Komalasari T, Harimurti S. A review of the anti-diabetic activity of *Andrographis paniculata* (burm. f.) nees based *in-vivo* study. Int J Public Heal Sci. 2015; 4(4): 256. doi:10.11591/ijphs.v4i4.4743
68. Ladan Z, Olanrewaju TO, Maikaje DB, Emmanuel RT, Apinega LA, Isaiah TJ, Isaiah NG, Waziri PM. In-vitro evaluation of the trypanocidal activity of *Andrographis paniculata* against *Trypanosoma brucei brucei*. Trop J Nat Prod Res. 2020; 4(10): 777-783. doi:10.26538/tjnpr/v4i10.19
69. Abiodun F, Osakue J, Uzoekwe A, Qiu S-X. Phytochemical and anticancer studies on ten medicinal plants used in Nigeria. Bayero J Pure Appl Sci. 2011; 4(1): 36-39. doi:10.4314/bajopas.v4i1.7
70. Abdelzaher WY, Khalaf HM, Bayoumi AMA, Shehata S, Refaie MMM. Role of nitric oxide donor in methotrexate-induced testicular injury via modulation of pro-inflammatory mediators , eNOS and P-glycoprotein. Hum Exp Toxicol. 2020; 39(12): 1700-1709.
71. Fadhil MA, Al-Bakri NA, Selman MO. Teratogenic effect of methotrexate on histogenesis. World J Pharm Res. 2016; 5(10): 79-88. doi:10.20959/wjpr201610-7068
72. Omolara OO. Annals of clinical toxicology induction of oxidative stress by methotrexate in the testicular tissue of *Swiss albino mice.* Ann Clin Toxicol. 2019; 2(3): 3-6.

Tropical Journal of Natural Product Research

TJNPR

www.tjnpr.org

Tropical Journal of
NATURAL PRODUCT RESEARCH

This journal is indexed in Open J-Gate, Crossref, Creative Commons, Index Copernicus, Google Scholar.

All published papers are DOI assigned.

Official Journal of Natural Product Research Group
University of Benin

Tropical Journal of Natural Product Research
Official Journal of Natural Product Research Group
ISSN: 2616-0684 (Print)
ISSN: 2616-0692 (Online)

Editorial Team

Editorial Board

Editor-in-Chief
Professor Abiodun Falodun
Professor of Pharmaceutical Chemistry
Natural product Research Group
University of Benin, Nigeria.
Email: editor.tjnpr@gmail.com;editor.tjnpr@uniben.edu
(mailto:editor.tjnpr@gmail.com;editor.tjnpr@uniben.edu)
Phone: +2348073184488

Associate Editors:

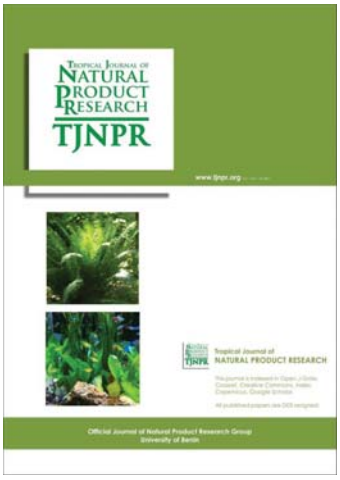
- **Professor Dr. Dr. Peter Langer,**Institute of Organic Chemistry, University of Rostock, (Germany)
- **Professor Frederick O. Ekhaise**, Microbiology, University of Benin, Nigeria.
- **Professor Martins Emeje**: Professor of Drug Delivery/Nanomedicine in the Department of Pharmaceutical Technology and Raw Materials Development (PT&RMD) at the National Institute of Pharmaceutical Research and Development.

Editorial Assistant:

- **Erharuyi Osayemwenre**, Faculty of Pharmacy, University of Benin, Nigeria.

Board Members

- **Professor Ikhlas A. Khan**, National Center for Natural Product Research, Mississippi (USA)
- **Professor Nosa Egiebor**, College of Environmental Science & Forestry, State University of New York
- **Professor Samuel Qiu**, South China Botanical Gardens, Chinese Academy of Sciences (China)
- **Professor Xavier Barril**, De Fisicoquimica-Facultat De Farmacia Universitat de Barcelona, (Spain)
- **Professor Abiodun Ogundiani**, Pharmaceutical Chemistry, OAU, Ile-Ife, (Nigeria)
- **Professor Thomas Kodadek,** The Scripps Research Institute, Scripps Florida (USA)
- **Professor Anthony B Ebeigbe**, Physiology, College of Medical Sciences, University of Benin, (Nigeria)
- **Professor Eric KI Omogbai**, Pharmacology and Toxicology, University of Benin, Nigeria
- **Professor Dr. Udo Kragl**, Institute of Organic Chemistry, University of Rostock, (Germany)
- **Professor Cyril O. Usifoh**, Faculty of Pharmacy, University of Benin, Nigeria.
- **Professor Azuka C Opara**, Clinical Pharmacy & Pharmacy Practice, University of Benin, (Nigeria).
- **Professor Ikhide G. Imumorin**, Biological Sciences, Georgia Institute of Technology, Atlanta (USA)
- **Professor Mark T. Hamann**, Medical University College, South Carolina (USA)
- **Professor Barbara Nebe**, University of Rostock, (Germany)
- **Professor Anthony I. Okoh**, University of Fort Hare, Alice (South Africa)
- **Professor Dr. M. Iqbal Choudhary**, HEJ, University of Karachi, (Pakistan)
- **Professor Omoanghe S. Isikhuemhen**, North Carolina A&T State University, (USA)
- **Professor Ezekiel Green**, University of Johannesburg, (South Africa)
- **Professor John Igoli**, Strathclyde Institute of Pharmacy and Biomedical Sciences, UK
- **Professor Peter Akah**, Pharmacology & Toxicology, University of Nigeria, Nigeria
- **Professor H.A.B. Coker**, Faculty of Pharmacy, University of Lagos (Nigeria)
- **Dr Kingsly Agho**, School of Science and Health, Western Sydney University (Australia)
- **E. Igbinosa,**Microbiology, University of Benin, Nigeria
- **Pius Fasinu**, School of Pharmacy, Campbell University (USA)
- **Professor Larry A Walker**, National Center for Natural Products Research, Mississippi,



(https://tjnpr.org/index.php/home/about/submissions)

USA

- **Dr. Alireza Heidari**, Faculty of Chemistry, California South University (CSU), Irvine, California, USA
- **Professor Iyere O Onoagbe**, Faculty of Life Sciences, University of Benin, (Nigeria)
- **Professor Broderick Eribo**, Department of Biology, Howard University, Washington DC, (USA)
- **Professor Simon Gibbons**, School of Pharmacy, University College London, UK
- **Professor Masashi Mizuno**, Laboratory of Food & Nutritional Chemistry, Kobe University, Japan
- **Professor FBC Okoye**, Professor of Medicinal and Pharmaceutical Chemistry, Nnamdi Azikiwe University, Awka

Editorial Team Role

The editorial team is responsible for handling the peer-review process of all manuscripts. The Editor-in-Chief receives all articles submitted by authors. The Editor-in-Chief forward the articles to the Managing Editor or Assistant Editor or the Section Editor who will first decide whether the article meets the formal criteria indicated in the Author Guidelines and whether it fits within the aims and scope of the journal.

All articles shall be handled by an Editorial board member who does not have any potential conflict of interest with any of the manuscript's authors. All Manuscripts will undergo a double-blind peer-review process, where the authors and reviewers do not know each other's identity to ensure the highest quality of the journal.

Article handling editor will select the potential reviewers for each article and must (i) not have co-authored publications with the author and (ii) not be affiliated with the same institution as the author(s). All articles except Editorials will be sent out for peer review process and at least two reviewer comments per manuscript will be collected. Reviewers will be asked to complete their review within two weeks; however, they are allowed to extend the review period of time in order to complete and submit their report.

Peer reviewers can make one of the following recommendations for the editors to consider:
1.Accept manuscript without any change
2. Accept after minor revision (i.e., article can be accepted if the author makes the requested minor revisions)
3. Accept after minor revision (i.e., article can be accepted after major revisions have been made – the manuscript may be sent out for another peer review round)
4. Reject manuscript (i.e., the manuscript is flawed or not sufficiently novel)

When all reviewers have submitted their reports, the Editor can make one of the following editorial recommendations:
1. Accept
2. Revision
3. Reject

Revision

Formal revision may be required if the language or style is sub-standard. To facilitate rapid publication, authors are given a maximum of two weeks for minor/major revisions, with possible extensions of up to 4 weeks. Number of revisions depends upon the need for number of changes/edits needed in the article as per the instructions from the editor/reviewers to ensure quality of the article before getting them published.

Publication

If the manuscript is accepted, the author will be sent a galley proof in order for them to make any final corrections. Once this is done the manuscript will appear in the Articles in Press section of the journal's website. All accepted peer reviewed manuscripts will be published online and are citable by the digital object identifier (DOI) assigned at the time of online publication.

Scopus SJ

Tropical Journal of Natural Product Research

Q3 Pharmaceutical Science

best quartile

SJR 2023 0.18

powered by scimagojr.com

0.6 2022 CiteScore

24th percentile

Powered by Scopus

Keywords

Publisher

Dean's Office,
Name of Publisher: Dr. Vincent O. Imieje,
Room 1, Second Floor,

Faculty of Pharmacy,
University of Benin,
PMB 1154
Benin City
Edo State, Nigeria.
Email: vincent.imieje@uniben.edu
(mailto:vincent.imieje@uniben.edu); vincent.imieje@gmail.com
(mailto:vincent.imieje@gmail.com)
Tel: +2348037890763

Tropical Journal of Natural Product Research
Official Journal of Natural Product Research Group
ISSN: 2616-0684 (Print)
ISSN: 2616-0692 (Online)

Published: 2023-07-01

Articles

Artonin E: A Short Review of its Chemistry, Sources, Anti-Cancer Activities and Other Pharmacological Properties

http://www.doi.org/10.26538/tjnpr/v7i6.1

(https://tjnpr.org/index.php/home/article/view/2065)

Eric W.C. Chan

3051-3058

pdf (https://tjnpr.org/index.php/home/article/view/2065/2867)
doi (https://tjnpr.org/index.php/home/article/view/2065/2870)
epub (https://tjnpr.org/index.php/home/article/view/2065/2871)

Review of the Gut Microbiota Dynamics in Type-2 Diabetes Mellitus (T2DM): A Focus on Human-Based Studies

http://www.doi.org/10.26538/tjnpr/v7i6.2

(https://tjnpr.org/index.php/home/article/view/2066)

Folusho O. Oluwaloni, Omolara F. Yakubu, Abiodun H. Adebayo, Oluwatosin D. Koyejo, Adekunle K. Lawal

:3059-3079

pdf (https://tjnpr.org/index.php/home/article/view/2066/2872)
doi (https://tjnpr.org/index.php/home/article/view/2066/2881)
epub (https://tjnpr.org/index.php/home/article/view/2066/2890)

Potential and Simulation of Optimization Design for Ozonation Process on Commercial Sterility Level of Coconut Water Product: A Review

http://www.doi.org/10.26538/tjnpr/v7i6.3

(https://tjnpr.org/index.php/home/article/view/2067)

David Yudianto, Ratih Dewanti-Hariyadi, Sukarno Sukarno, Muhammad Nur, Eko H. Purnomo

3080-3100

pdf (https://tjnpr.org/index.php/home/article/view/2067/2873)
doi (https://tjnpr.org/index.php/home/article/view/2067/2882)
epub (https://tjnpr.org/index.php/home/article/view/2067/2891)

Effect of Rosella (Hibiscus sabdariffa. L) Consumption on Total Cholesterol Levels

http://www.doi.org/10.26538/tjnpr/v7i6.4

(https://tjnpr.org/index.php/home/article/view/2068)

Slamet Slamet, Etiek Nurhayati, Dian Novitasari, Tommy D. Irianto

3101-3104

pdf (https://tjnpr.org/index.php/home/article/view/2068/2874)
doi (https://tjnpr.org/index.php/home/article/view/2068/2883)
epub (https://tjnpr.org/index.php/home/article/view/2068/2892)

Antioxidant and Antibacterial Activities of Allium sativum Ethanol

(https://tjnpr.org/index.php/home/article/view/2069)

Extract and Silver Nanoparticles
http://www.doi.org/10.26538/tjnpr/v7i6.5

(https://tjnpr.org/index.php/home/article/view/2069)

Huda K. Al-Saadi, Hussein A. Awad, Zahraa S. Saltan, Butheina A. Hasoon, Afnan I. Abdulwahab, Khalida F. Al-azawi, Bahaa A.L. Al-Rubaii

3105-3110

pdf (https://tjnpr.org/index.php/home/article/view/2069/2875)

doi (https://tjnpr.org/index.php/home/article/view/2069/2884)

epub (https://tjnpr.org/index.php/home/article/view/2069/2893)

(https://tjnpr.org/index.php/home/article/view/2070)

Protective Effects of Curcumin against Nicotine-Induced Damage on Esophagus Tissue in the Wister Rat
http://www.doi.org/10.26538/tjnpr/v7i6.6

(https://tjnpr.org/index.php/home/article/view/2070)

Alia S. Khwaldeh

3111-3113

pdf (https://tjnpr.org/index.php/home/article/view/2070/2876)

doi (https://tjnpr.org/index.php/home/article/view/2070/2885)

epub (https://tjnpr.org/index.php/home/article/view/2070/2894)

(https://tjnpr.org/index.php/home/article/view/2071)

Effect of Solvent Extraction on Antityrosinase and Sun Protection Factor of Mulberry (Morus alba L.) Cultivated in Wajo, Indonesia
http://www.doi.org/10.26538/tjnpr/v7i6.7

(https://tjnpr.org/index.php/home/article/view/2071)

Lukman Muslimin, Tuti H Zainal, Besse Hardianti, Megawati Megawati, Marwati Marwati

3114-3118

pdf (https://tjnpr.org/index.php/home/article/view/2071/2877)

doi (https://tjnpr.org/index.php/home/article/view/2071/2886)

epub (https://tjnpr.org/index.php/home/article/view/2071/2895)

(https://tjnpr.org/index.php/home/article/view/2072)

Exploring the Polyphenol Contents and Antioxidant Capacity of the Leaf Extracts of Selected Indonesian Syzygium Species
http://www.doi.org/10.26538/tjnpr/v7i6.8

(https://tjnpr.org/index.php/home/article/view/2072)

Agustin Yumita, Ni P.E. Hikmawanti, Endang Hanani, Cindi W. Saputri, Putri H. Hanana, Jeanne N.D. Ero, Mayang Marcelena, Tazqiyah Baytisani, Febby A. Sofiana, Amanda F. Shania, Erlina S.A. Saputri, Firda P.N. Islami

3119-3124

pdf (https://tjnpr.org/index.php/home/article/view/2072/2878)

doi (https://tjnpr.org/index.php/home/article/view/2072/2887)

epub (https://tjnpr.org/index.php/home/article/view/2072/2896)

(https://tjnpr.org/index.php/home/article/view/2073)

In Silico and In Vitro Study of The Ethanol Extract of The White Garland Lily (Hedychium coronarium J. Koenig) as a Tyrosinase Inhibitor
http://www.doi.org/10.26538/tjnpr/v7i6.9

(https://tjnpr.org/index.php/home/article/view/2073)

Netty Suharti, Mike R. Sari, Dwisari Dillasamola, Purnawan P. Putra

3125-3129

pdf (https://tjnpr.org/index.php/home/article/view/2073/2879)

doi (https://tjnpr.org/index.php/home/article/view/2073/2888)

epub (https://tjnpr.org/index.php/home/article/view/2073/2897)

(https://tjnpr.org/index.php/home/article/view/2064)

Assessment of the Effect of Thyme Essential Oil on Biochemical Parameters in Endurance Horses
http://www.doi.org/10.26538/tjnpr/v7i6.10

(https://tjnpr.org/index.php/home/article/view/2064)

Fouzia Dahmani, Karima El-Mouhdi, Fatima Zahra Laamiri, Mohammed Ibriz

3130-3135

Keywords

Publisher

Dean's Office,
Name of Publisher: Dr. Vincent O. Imieje,
Room 1, Second Floor,
Faculty of Pharmacy,
University of Benin,
PMB 1154
Benin City
Edo State, Nigeria.
Email: vincent.imieje@uniben.edu (mailto:vincent.imieje@uniben.edu); vincent.imieje@gmail.
(mailto:vincent.imieje@gmail.com)
Tel: +2348037890763

pdf (https://tjnpr.org/index.php/home/article/view/2064/2880)

doi (https://tjnpr.org/index.php/home/article/view/2064/2889)

epub (https://tjnpr.org/index.php/home/article/view/2064/2898)

(https://tjnpr.org/index.php/home/article/view/2088)

Impact of Rainfall on The Distribution of Water-Borne Diseases: The Case of Viral Hepatitis

http://www.doi.org/10.26538/tjnpr/v7i6.11

(https://tjnpr.org/index.php/home/article/view/2088)

Hajar EL Omari, Karima El-Mouhdi, Khadija Ouarrak, Fatima Z. Talbi, Fatimaezzahra Mesbah, Fatima Z. Milouk, Fouzia Dahmani, Ilham Lhilali, Jihane El Amrani, Abdelhakim E. Lalami

3136-3139

pdf (https://tjnpr.org/index.php/home/article/view/2088/2899)

doi (https://tjnpr.org/index.php/home/article/view/2088/2909)

epub (https://tjnpr.org/index.php/home/article/view/2088/2919)

(https://tjnpr.org/index.php/home/article/view/2089)

The Effects of Methotrexate, Moringa oleifera Leaf Extract, and Andrographis paniculata Leaf Extract on the Testes of Hyperglycemic Wistar Rats

http://www.doi.org/10.26538/tjnpr/v7i6.12

(https://tjnpr.org/index.php/home/article/view/2089)

Muhammad H.F. Nasution, Viskasari P. Kalanjati, Abdurachman Abdurachman, Dwi M. N. Aditya, Dimas B. B. Pamungkas, Maya R. Syamhadi

3140-3146

pdf (https://tjnpr.org/index.php/home/article/view/2089/2900)

doi (https://tjnpr.org/index.php/home/article/view/2089/2910)

epub (https://tjnpr.org/index.php/home/article/view/2089/2920)

(https://tjnpr.org/index.php/home/article/view/2090)

Chemical Constituents and Biological Activities of Commersonia bartramia Stems

http://www.doi.org/10.26538/tjnpr/v7i6.13

(https://tjnpr.org/index.php/home/article/view/2090)

Kieu C. Nhung, Tran T. Bach, Vu T. Hue, Bui T. Ha, Le N. Thanh

3147-3152

pdf (https://tjnpr.org/index.php/home/article/view/2090/2901)

doi (https://tjnpr.org/index.php/home/article/view/2090/2911)

epub (https://tjnpr.org/index.php/home/article/view/2090/2921)

(https://tjnpr.org/index.php/home/article/view/2081)

Evaluation of Pain-Relieving Effect of The Herbal Remedy “Hoang Ky Que Chi Ngu Vat Thang” in Animal Model

http://www.doi.org/10.26538/tjnpr/v7i6.14

(https://tjnpr.org/index.php/home/article/view/2081)

Hoang M. Le, Nuong T.K. Huynh, Tuan T. Vo, Tien T.B. Nguyen, Quan M. Nguyen

3153-3157

pdf (https://tjnpr.org/index.php/home/article/view/2081/2902)

doi (https://tjnpr.org/index.php/home/article/view/2081/2912)

epub (https://tjnpr.org/index.php/home/article/view/2081/2922)

(https://tjnpr.org/index.php/home/article/view/2082)

Synthesis, Anti-breast Cancer Activity, and Molecular Docking Studies of Thiourea Benzamide Derivatives and Their Complexes with Copper Ion

http://www.doi.org/10.26538/tjnpr/v7i6.15

(https://tjnpr.org/index.php/home/article/view/2082)

Yaqeen M. Al-Salim, Rafid H. Al-Asadi

3158-3167

pdf (https://tjnpr.org/index.php/home/article/view/2082/2903)

doi (https://tjnpr.org/index.php/home/article/view/2082/2913)

epub (https://tjnpr.org/index.php/home/article/view/2082/2923)


(https://tjnpr.org/index.php/home/article/view/2100)

Acute Toxicity of Aqueous Extract of a Diabetic Folklore Recipe Thai Traditional Medicine in Rats
http://www.doi.org/10.26538/tjnpr/v7i6.16
(https://tjnpr.org/index.php/home/article/view/2100)
Teeraporn Katisart, Luchai Butkhup, Adisak Sumalee, Ladachart Taepongsorat, Ampa Konsue
3168-3176

pdf (https://tjnpr.org/index.php/home/article/view/2100/2930)
doi (https://tjnpr.org/index.php/home/article/view/2100/2936)
epub (https://tjnpr.org/index.php/home/article/view/2100/2941)


(https://tjnpr.org/index.php/home/article/view/2101)

Antihyperlipidemic Activity of Purified Polyphenol Extracted from Water Lettuce (Pistia stratiotes) Leaf: An In Vitro Analysis
http://www.doi.org/10.26538/tjnpr/v7i6.17
(https://tjnpr.org/index.php/home/article/view/2101)
Sabri Sudirman, Nurachma Pujiastuti, Miftahul Janna, Herpandi, Indah Widiastuti
3177-3181

pdf (https://tjnpr.org/index.php/home/article/view/2101/2931)
doi (https://tjnpr.org/index.php/home/article/view/2101/2937)
epub (https://tjnpr.org/index.php/home/article/view/2101/2942)


(https://tjnpr.org/index.php/home/article/view/2102)

Evaluation of the Antimicrobial Activity of Bacteriocin-Producing Lactic Acid Bacteria Isolated from Human Intestine against Pathogenic Microorganisms
http://www.doi.org/10.26538/tjnpr/v7i6.18
(https://tjnpr.org/index.php/home/article/view/2102)
Maisa M.A. Al-Qudah, Razan J. Rahahleh, Wesal Y. Alraei, Thana' Y. Aljaraedah, Hashem A. Abu-Harirah, Kawther F. Amawi, Jafar M. F. El-Qudah
3182-3190

pdf (https://tjnpr.org/index.php/home/article/view/2102/2932)
doi (https://tjnpr.org/index.php/home/article/view/2102/2938)
epub (https://tjnpr.org/index.php/home/article/view/2102/2943)


(https://tjnpr.org/index.php/home/article/view/2103)

Characterization of Chemical Constituents of Adansonia digitata L. using GC-MS and LC-MS/QTOF and their In Vitro Anti-cervical Cancer Effects
http://www.doi.org/10.26538/tjnpr/v7i6.19
(https://tjnpr.org/index.php/home/article/view/2103)
Mohammed B. Suliman, Sanadelaslam El-Hddad
3191-3197

pdf (https://tjnpr.org/index.php/home/article/view/2103/2933)
doi (https://tjnpr.org/index.php/home/article/view/2103/2939)
epub (https://tjnpr.org/index.php/home/article/view/2103/2944)


(https://tjnpr.org/index.php/home/article/view/2104)

Enhancing Metabolic Parameters: The Impact of Porang Glucomannan on Body Weight, Intraperitoneal Fat, Fasting Blood Glucose, and GLUT-4 Levels in Rats Fed a High-Fat and High-Carbohydrate Diet
http://www.doi.org/10.26538/tjnpr/v7i6.20
(https://tjnpr.org/index.php/home/article/view/2104)
Azizah H. Safitri, Eni Widayati, Nurina Tyagita
3198-3202

pdf (https://tjnpr.org/index.php/home/article/view/2104/2934)
doi (https://tjnpr.org/index.php/home/article/view/2104/2940)
epub (https://tjnpr.org/index.php/home/article/view/2104/2945)


(https://tjnpr.org/index.php/

A Phenylpropanoid Compound from the Seeds of Sterculia quadrifida and its Cytotoxic Activity
http://www.doi.org/10.26538/tjnpr/v7i6.21
(https://tjnpr.org/index.php/home/article/view/2105)

home/article/view/2105)

Rollando Rollando, Eva Monica, Muhammad Hilmi Afthoni, Warsito Warsito, Masruri Masruri, Nashi Widodo
3203-3208

pdf (https://tjnpr.org/index.php/home/article/view/2105/2946)

doi (https://tjnpr.org/index.php/home/article/view/2105/2951)

epub (https://tjnpr.org/index.php/home/article/view/2105/2956)

(https://tjnpr.org/index.php/home/article/view/2106)

Effects of Aqueous Leaf Extracts of Loranthus micranthus Linn. on Biochemical Profile of Wistar Rats Infected with Trypanosoma brucei brucei

http://www.doi.org/10.26538/tjnpr/v7i6.22

(https://tjnpr.org/index.php/home/article/view/2106)

Jude V. Egbuji, Vincent C. Ejere, Godwin C. Ugwu, Chinagorom L. Ugwu
3209-3214

pdf (https://tjnpr.org/index.php/home/article/view/2106/2947)

doi (https://tjnpr.org/index.php/home/article/view/2106/2952)

epub (https://tjnpr.org/index.php/home/article/view/2106/2957)

(https://tjnpr.org/index.php/home/article/view/2107)

Modulatory Effects of Aqueous Leaf Extract of Gongronema latifolium (asclepiadaceae) on Some Natural and Adaptive Immune Responses in Rodents

http://www.doi.org/10.26538/tjnpr/v7i6.23

(https://tjnpr.org/index.php/home/article/view/2107)

Chioma Igwilo, Moses Ikegbunam, Stella A. Ihim, Collins A. Onyeto, Christopher E.C. Ugwoke, Njideka Onyia, Chukwuemeka S. Nworu
3223-3229

pdf (https://tjnpr.org/index.php/home/article/view/2107/2948)

doi (https://tjnpr.org/index.php/home/article/view/2107/2953)

epub (https://tjnpr.org/index.php/home/article/view/2107/2958)

(https://tjnpr.org/index.php/home/article/view/2108)

Ameliorative Potential of Thymoquinone on Male Reproductive Functions in Lead Acetate-Induced Reproductive Toxicity in Male Wistar Rats

http://www.doi.org/10.26538/tjnpr/v7i6.24

(https://tjnpr.org/index.php/home/article/view/2108)

Kabiru I. Adedokun, Olayemi O. Oladokun, Tunde F. Abraham, Opeyemi S. Osuntokun, Tope G. Atere, Sakinat T. Baiyewu
3223-3229

pdf (https://tjnpr.org/index.php/home/article/view/2108/2949)

doi (https://tjnpr.org/index.php/home/article/view/2108/2954)

epub (https://tjnpr.org/index.php/home/article/view/2108/2959)

(https://tjnpr.org/index.php/home/article/view/2109)

Evaluation of Antidepressant-Like Activity of Solvent Partitioned Fractions of Olax subscorpioidea Oliv. (Olacaceae) Leaf Extract in Rodents

http://www.doi.org/10.26538/tjnpr/v7i6.25

(https://tjnpr.org/index.php/home/article/view/2109)

Olusegun A. Adeoluwa, Isaiah O. Agboola, Elizabeth T. Akinluyi, Gladys O. Adeoluwa, Adegbuyi O. Aderibigbe
3230-3235

pdf (https://tjnpr.org/index.php/home/article/view/2109/2950)

doi (https://tjnpr.org/index.php/home/article/view/2109/2955)

epub (https://tjnpr.org/index.php/home/article/view/2109/2960)

(https://tjnpr.org/index.php/home/article/view/2110)

Annona muricata L., Stem-Bark Exhibit Antidepressant-Like Activity in Sprague Dawley Rats

http://www.doi.org/10.26538/tjnpr/v7i6.26

(https://tjnpr.org/index.php/home/article/view/2110)

Ewenodere O. Bikomo, Sikiru A. Ojokuku, Mary Niemogha
3236-3239

pdf (https://tjnpr.org/index.php/home/article/view/2110/2961)

doi (https://tjnpr.org/index.php/home/article/view/2110/2966)

epub (https://tjnpr.org/index.php/home/article/view/2110/2968)

Optimization of Culture Conditions for Lipase Production by Pseudomonas aeruginosa ECS3

http://www.doi.org/10.26538/tjnpr/v7i6.27

(https://tjnpr.org/index.php/home/article/view/2111)

Adefunke O. Ogunniran, Bose O. Odeleye, Titilayo O. Femi-Ola

3240-3245

pdf (https://tjnpr.org/index.php/home/article/view/2111/2962)

doi (https://tjnpr.org/index.php/home/article/view/2111/2967)

epub (https://tjnpr.org/index.php/home/article/view/2111/2975)

Development of Diclofenac and Capsaicin Emulgel for the Management of Inflammation in Rheumatoid Arthritis

http://www.doi.org/10.26538/tjnpr/v7i6.28

(https://tjnpr.org/index.php/home/article/view/2112)

Nnadozie K. Okoro, Bukola A. Oseni, Omotunde O. Okubanjo, Adeola A. Adegun, Margaret O. Ilomuanya

3246-3252

pdf (https://tjnpr.org/index.php/home/article/view/2112/2963)

doi (https://tjnpr.org/index.php/home/article/view/2112/2969)

epub (https://tjnpr.org/index.php/home/article/view/2112/2970)

Mathematical Modelling of the Drying Kinetics and Optimization of Process Conditions for Tilapia zillii Fillets Dried in a Convection Oven

http://www.doi.org/10.26538/tjnpr/v7i6.29

(https://tjnpr.org/index.php/home/article/view/2113)

Olayinka Sanda, Deborah A. Sanda, Elijah A. Taiwo, Charity O. Aremu, John O. Ojediran, Bamidele S. Fakinle

3253-3262

pdf (https://tjnpr.org/index.php/home/article/view/2113/2965)

doi (https://tjnpr.org/index.php/home/article/view/2113/2972)

epub (https://tjnpr.org/index.php/home/article/view/2113/2974)

Knowledge, Practice, and Behavior of University Students Concerning Sandfly Vectors of Leishmaniasis in Fez City, Central North Morocco

http://www.doi.org/10.26538/tjnpr/v7i6.30

(https://tjnpr.org/index.php/home/article/view/2114)

Youness El Fattouhi, Najoua Darkaoui, Fatima Z. Talbi, Abdellatif J. Idrissi, Abdelhakim El Ouali Lalami

3263-3270

pdf (https://tjnpr.org/index.php/home/article/view/2114/2964)

doi (https://tjnpr.org/index.php/home/article/view/2114/2971)

epub (https://tjnpr.org/index.php/home/article/view/2114/2973)

ERRATUM: Antimicrobial Effect of Cassia alata Leaf Extracts on Fungal Isolates from Tinea Infections

http://www.doi.org/10.26538/tjnpr/v7i5.29

(https://tjnpr.org/index.php/home/article/view/2118)

Ofonime M. Ogba, Dora I. Udoh, Mfoniso I. Udonkang, Aniekan-Augusta O. Eyo, Stephenie E. Chukwueke, Ziregbe Eshemitan, Nseobong G. Akpan

3034-3037

pdf (https://tjnpr.org/index.php/home/article/view/2118/2976)

doi (https://tjnpr.org/index.php/home/article/view/2118/2977)

epub (https://tjnpr.org/index.php/home/article/view/2118/2978)

Tropical Journal of Natural Product Research

COUNTRY

Nigeria

Universities and research institutions in Nigeria

Media Ranking in Nigeria

SUBJECT AREA AND CATEGORY

Biochemistry, Genetics and Molecular Biology
- Biochemistry
- Molecular Medicine

Chemistry
- Analytical Chemistry

Medicine
- Complementary and Alternative Medicine

Pharmacology, Toxicology and Pharmaceutics
- Drug Discovery
- Pharmaceutical Science
- Pharmacology

PUBLISHER

Faculty of Pharmacy, University of Benin

H-INDEX

11

PUBLICATION TYPE

Journals

ISSN

26160684, 26160692

COVERAGE

2017-2023

INFORMATION

Homepage

How to publish in this journal

Contact

SCOPE

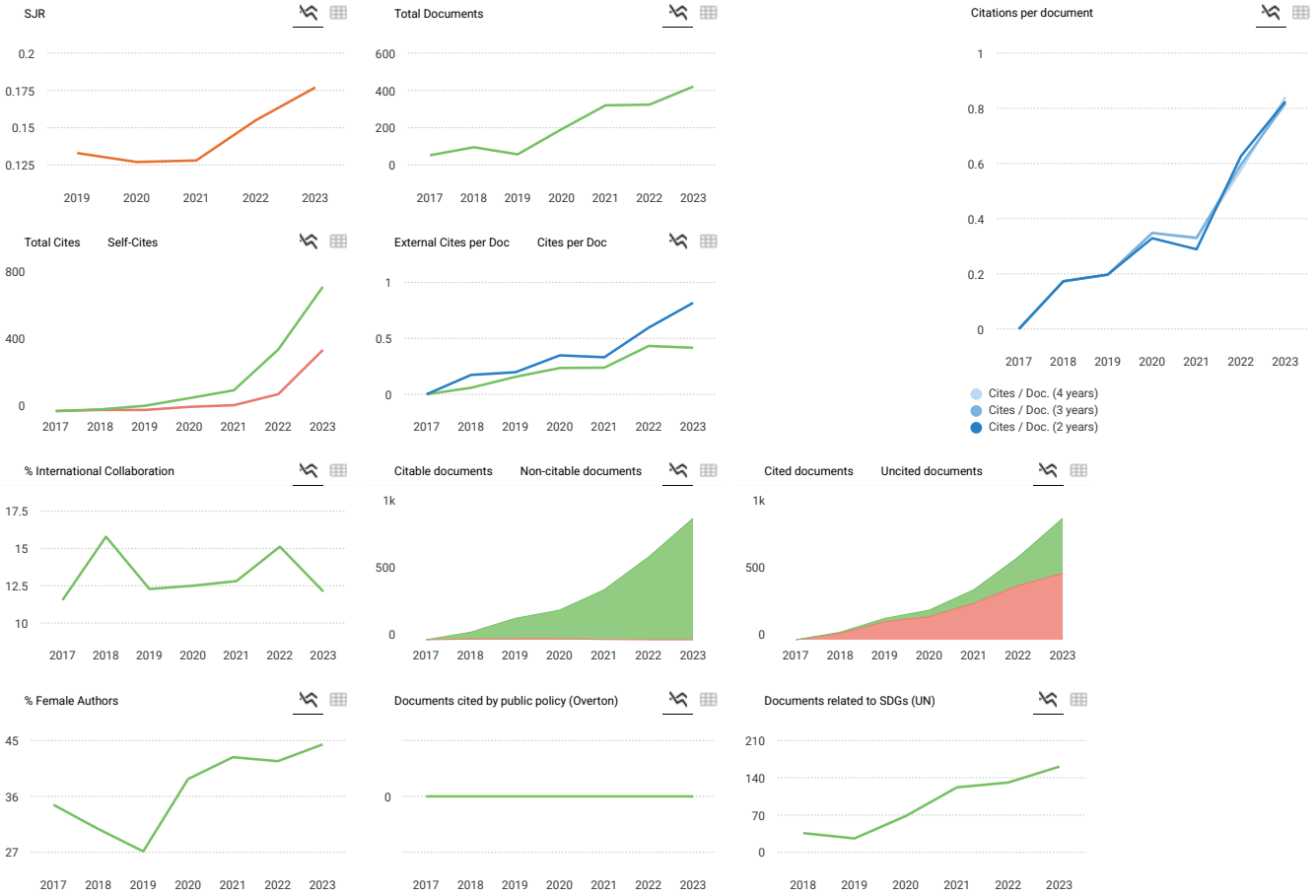
The Tropical Journal of Natural Product Research is open access, peer-reviewed international journal aimed at making important contributions in the field of Natural Product Research, Pharmaceutical and Natural Sciences. The journal covers all aspects of Pharmaceutical research, chemistry and biochemistry of naturally occurring compounds, ethnomedicine, ethnopharmacology, pharmacognosy, biomedical research, biotechnology and related disciplines. The journal welcome submissions from a broad spectrum of scientific endeavour involving biological evaluation of natural substances of plant, microbial and animal origin against different disease targets, processes or therapeutic strategies that can lead to or assist in the prevention and management of chronic and infectious diseases, clinical therapeutics, Isolation and characterization of metabolites, structure elucidation, synthesis and experimental biosynthesis of natural Product as well as developments of methods in these areas. Research papers in the fields of chemistry-biology boundary, e.g. fermentation chemistry, plant tissue culture investigations etc. are also welcomed. Although the journal focuses mainly on original research articles, timely, concise and focused reviews on recent progress in active areas of natural Product is also encouraged.

Quartiles

FIND SIMILAR JOURNALS

options

1	2	3	4	5
Journal of HerbMed Pharmacology	**Natural Products Journal**	**Phytomedicine Plus**	**Journal of Natural Remedies**	**Advances in Traditional Medicine**
IRN	NLD	NLD	IND	SGP
69% similarity	67% similarity	67% similarity	66% similarity	66% similarity



← Show this widget in your own website

Just copy the code below and paste within your html code:

<a href="https://www.scima

SCImago Graphica

Explore, visually communicate and make sense of data with our **new data visualization tool.**

Metrics based on Scopus® data as of March 2024

A **Abiodun** 1 month ago

Please when is Tropical Journal of Natural Product due for upgrading to Q2? Presently the journal is Q3 with good citations. When will the journal be evaluated for Q2?

reply

SCImago Team

Melanie Ortiz 1 month ago

Dear Abiodun,

Thank you for contacting us. Our data come from Scopus, they annually send us an update of the data. This update is sent to us around April / May every year. The SJR for 2023 was released on April 13th, 2024. Therefore, the indicators for 2024 will be available

in May/June 2025 and before that date we can´t know what will happen with this journal. Best Regards, SCImago Team

S **saleha Suleman Khan** 3 months ago

is there any impact factor of this journal? my paper was published in 2018 at that time what was the impact factor of this journal?

reply

SCImago Team

Melanie Ortiz 2 months ago

Dear Saleha, thank you very much for your comment. SCImago Journal and Country Rank uses Scopus data, our impact indicator is the SJR (Check it above). We suggest you consult the Journal Citation Report for other indicators (like Impact Factor) with a Web of Science data source. Best Regards, SCImago Team

H **hesham essam** 12 months ago

please, I want to ask whether the journal is indexed in scopus till now 1-2-2024

reply

Y **Yurnadi** 11 months ago

The journal is indexed in scopus. Please check link below:

https://www.scopus.com/record/display.uri?eid=2-s2.0-85186880420

SCImago Team

Melanie Ortiz 12 months ago

Dear Hesham, thank you very much for your comment. We suggest you consult the Scopus database directly. Keep in mind that the SJR is a static image (the update is made one time per year) of a database (Scopus) which is changing every day.
The Scopus' update list can also be consulted here:
https://www.elsevier.com/solutions/scopus/how-scopus-works/content
Best Regards, SCImago Team

G **Grifith** 2 years ago

Whichbis tjpnr.org quartil?q3 or q4?

reply

SCImago Team

Melanie Ortiz 2 years ago

Dear Grifith, thank you very much for your request. You can consult that information just above. Best Regards, SCImago Team

T **Tamta Ar** 2 years ago

It seems like this journal is not indexed anymore in scopus. It is clearly highlighted in scopus that the Scopus coverage years:from 2017 to 2022.

reply

R **Rollando** 2 years ago

Scopus coverage years:from 2017 to Present

SCImago Team

Melanie Ortiz 2 years ago

Dear Tamta,
Thank you very much for your comment.
All the metadata have been provided by Scopus /Elsevier in their last update sent to SCImago, including the Coverage's period data. The SJR for 2021 was released on 11 May

2022. We suggest you consult the Scopus database directly to see the current index status as SJR is a static image of Scopus, which is changing every day.
The Scopus' update list can also be consulted here:
https://www.elsevier.com/solutions/scopus/how-scopus-works/content
Best Regards, SCImago Team

F **fita** 2 years ago

Dear, I need to know if this journal is indexed in Scopus.Thank you.

reply

Sriram 2 years ago

Yes. It's index in scopus

SCImago Team

Melanie Ortiz 2 years ago

Dear Fita,
Thank you very much for your comment.
All the metadata have been provided by Scopus /Elsevier in their last update sent to SCImago, including the Coverage's period data. The SJR for 2021 was released on 11 May 2022. We suggest you consult the Scopus database directly to see the current index status as SJR is a static image of Scopus, which is changing every day.
The Scopus' update list can also be consulted here:
https://www.elsevier.com/solutions/scopus/how-scopus-works/content
Best Regards, SCImago Team

O **Oumaima** 3 years ago

Hello,

My manuscript was accepted and I paid the publication fee. I sent a lot of emails to the editor of the journal, but haven't received any response. It's normal?

reply

P **Prisca** 1 year ago

Is your article finally published in this TJNPR journal? My manuscript was accepted and I paid the fee since May 2023 but until now still not published as promised. I have sent multiple emails but the response was just to wait. Until not published (already 3 months).

A **Alex** 2 years ago

I have paid USD270 as publication fee, not getting response even after multiple email follow-ups.

Is this normal?

A **Alex** 2 years ago

iam facing similar issue

Mahraz Mohamed Adil 2 years ago

Oumaima le problème est réglé ?

N **Nawal** 3 years ago

Please, I want to ask you has your manuscript been published in this journal? as I have the same problem now

SCImago Team

Melanie Ortiz 3 years ago

Dear Oumaima,
Thank you for contacting us. Unfortunately, SCImago cannot help you with your

request.SJR is committed to help decision-making through scientometric indicators.
Best Regards, SCImago Team

A **amr ismail** 3 years ago

Introduction
Cardiovascular compromise is common in sick term and preterm infants. Impaired myocardial contractility and low cardiac output are common complications of such conditions as respiratory distress syndrome and Perinatal Asphyxia (Clark et al., 2016).
This reduced cardiovascular reserve may present clinically with hypotension, which is associated with increased mortality and adverse neurological outcomes. It has been suggested that this myocardial dysfunction, or stunning, is due to ischemia and/or necrosis(So You et al., 2020).
Cardiac biomarkers are being increasingly incorporated into clinical trials as indicators of myocardial strain. Furthermore, they can possibly be used to guide therapy and improve outcome. They are potential tools in the diagnosis and treatment of neonatal disease that is complicated by circulatory compromise (Daniel et al., 2017).
Previous studies in neonates have used creatine kinase isoforms as Biochemical markers of myocardial injury. However, these markers have been largely discarded because gestation, sex, mode of delivery, and birth weight all affect creatine kinase activity (Clark et al., 2016)
Cardiac troponin T (cTnT) is a regulatory contractile protein whose detection in the circulation has been shown to be a specific and sensitive marker for ischemic myocardial cell injury both in adult and pediatric populations (Thygesenet al., 2017).
Specific forms of the three troponin subunits T, C, and I exist in different muscle types. Cardiac specific troponins T and I have become established as the best biochemical markers for myocardial necrosis (Nikhileshet al., 2015).
They start to increase two hours after myocardial infarction, and concentrations can remain raised for up to two weeks after a full thickness infarct (Nikhileshet al., 2015).
Cardiac troponin T is detectable in the blood of many healthy neonates, but no relation with important basic and clinical variables was found. Sick infants have significantly higher concentrations than healthy infants. The variations in cardiac troponin T concentration were significantly associated with oxygen requirement or the use of inotropic support in a regression model. Cardiac troponin T may be a useful marker of neonatal and cardiorespiratory morbidity (Clark et al., 2016)

reply

SCImago Team

Melanie Ortiz 3 years ago

Dear Ismael,
Thank you for contacting us.
We are sorry to tell you that SCImago Journal & Country Rank is not a journal. SJR is a portal with scientometric indicators of journals indexed in Elsevier/Scopus.
Unfortunately, we cannot help you with your request, we suggest you visit the journal's homepage (See submission/author guidelines) or contact the journal's editorial staff , so they could inform you more deeply.
Best Regards, SCImago Team

P **paula** 4 years ago

will the articles published in this journal in 2021 are indexed in scopus ?

reply

SCImago Team

Melanie Ortiz 4 years ago

Dear Paula,
Thank you for contacting us. A paper will be considered as Scopus indexed as long as it has been published in the same period in which Scopus has indexed the journal. For this reason, we always recommend to consult the Scopus database directly to see the current status of a journal.
Best Regards, SCImago Team

S **sanae** 4 years ago

I need to know if this journal is indexed in Scopus.

reply

M **Mohammed KARA** 4 years ago

yes is indexed

SCImago Team

Melanie Ortiz 4 years ago

Dear Sanae,
Thank you very much for your comment.
All the metadata have been provided by Scopus /Elsevier in their last update sent to SCImago, including the Coverage's period data. The SJR for 2020 has been released on 17 May 2021. We suggest you consult the Scopus database directly to see the current index status as SJR is a static image of Scopus, which is changing every day.
Best Regards, SCImago Team

D **Dr John A. Udobang** 4 years ago

I sent in a manuscript for publication. I don't seem to find how to follow up its progress.

reply

P **Prisca** 1 year ago

Is your article finally published in this TJNPR journal? My manuscript was accepted and I paid the fee since May 2023 but until now still not published as promised. I have sent multiple emails but the response was just to wait. Until not published (already 3 months).

SCImago Team

Melanie Ortiz 4 years ago

Dear Dr John, thank you very much for your comment. Unfortunately, we cannot help you with your request, we suggest you contact the journal's editorial staff so they could inform you more deeply. Best Regards, SCImago Team

A **ABIODUN FALODUN** 4 years ago

The TJNPR www.tjnpr.org was Q3 but suddenly changed to Q4. Please need explanation

reply

SCImago Team

Melanie Ortiz 4 years ago

Dear Abiodun,
thank you very much for your comment. SJR has been updated on 11 June 2020 (it is updated only once a year).
Each year, Scopus provides us an update of their database and, according to that information, the scientometric indicators are calculated. The annual data's update can change the journal's quartile.
Best Regards, SCImago Team

Leave a comment

Name

Email
(will not be published)

Submit

The users of Scimago Journal & Country Rank have the possibility to dialogue through comments linked to a specific journal. The purpose is to have a forum in which general doubts about the processes of publication in the journal, experiences and other issues derived from the publication of papers are resolved. For topics on particular articles, maintain the dialogue through the usual channels with your editor.

Developed by: SCImago

Powered by: Scopus

Follow us on @ScimagoJR

Source details

Tropical Journal of Natural Product Research

Years currently covered by Scopus: from 2017 to 2024

Publisher: Faculty of Pharmacy, University of Benin

ISSN: 2616-0684 E-ISSN: 2616-0692

Subject area: Pharmacology, Toxicology and Pharmaceutics: Pharmaceutical Science | Medicine: Complementary and Alternative Medicine | Pharmacology, Toxicology and Pharmaceutics: Pharmacology | Chemistry: Analytical Chemistry | View all

Source type: Journal

CiteScore 2023
1.1

SJR 2023
0.177

SNIP 2023
0.373

View all documents | Set document alert | Save to source list

CiteScore | CiteScore rank & trend | Scopus content coverage

CiteScore 2023

$$1.1 = \frac{1{,}396 \text{ Citations } 2020 - 2023}{1{,}257 \text{ Documents } 2020 - 2023}$$

Calculated on 05 May, 2024

CiteScoreTracker 2024

$$1.6 = \frac{2{,}500 \text{ Citations to date}}{1{,}584 \text{ Documents to date}}$$

Last updated on 05 February, 2025 • Updated monthly

CiteScore rank 2023

Category	Rank	Percentile
Pharmacology, Toxicology and Pharmaceutics Pharmaceutical Science	#121/183	34th
Medicine Complementary	#79/105	25th

View CiteScore methodology | CiteScore FAQ | Add CiteScore to your site

About Scopus

What is Scopus

Content coverage

Scopus blog

Scopus API

Privacy matters

Language

日本語版を表示する

查看简体中文版本

查看繁體中文版本

Просмотр версии на русском языке

Customer Service

Help

Tutorials

Contact us