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Research Article

Curative Potential of *Abutilon indicum* Extract against Heat Stress-induced Kidney Damage in Adult Male Rats

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ABSTRACT

Introduction: The pharmacological activity of *Abutilon indicum* plant has been studied in various animal groups and clinical trials. This study aimed to investigate the protective role and mechanism of *Abutilon indicum* on adult male rats with heat stress-induced acute kidney injury.

Materials and methods: *Abutilon indicum* was obtained from the Botany Department of Al-Muthanna University, Iraq. The seeds, roots, and leaves of *Abutilon indicium* were prepared as an aqueous extract. In this experiment, 30 male albino rats, aged eight weeks, with an average weight of 200 ± 20 g. were recruited. After acclimation for a week, the rats were divided randomly into three groups, 10 male rats in each group.

The GI group (negative control) received daily oral treatment with saline via gavage for 28 days. In contrast, the GII group (positive control) was subjected to heat exposure and moisture stress. The GIII group was exposed to heat stress, involving a temperature increase of 40°C for 5 hours each day using electric heaters and humidity levels ranging from 75% to 85% for 5 hours daily (from 12:00 pm to 03:00 pm) over a four-week period. Additionally, the GIII group received oral treatment with fresh *Abutilon Indicum* extract at a dosage of 400 mg/kg of body weight for the first 12 hours of each day for 28 days.

Results: The results of this study revealed a significant decrease in biochemical parameters (blood urea and serum creatinine) in the GIII group, compared to GII group. Additionally, the histological analysis identified glomerulolysis and degeneration with dilation of the capsule zone in the GII group, while the GIII showed a decrease in capillary congestion with the severity of pathological damage reduced.

Conclusion: Considering the obtained results, it can be concluded that *Abutilon Indicum* extract has a significant positive effect on the biochemical parameters of the rats' kidney damage induced by heat stress.

1. Introduction

The pharmacological activity of *Abutilon indicum* (*A. indicum*) plant has been studied in various animal groups and clinical trials, which have demonstrated antitumor, antioxidative, antifungal, antiproliferative, antimicrobial, cytotoxicity, and antioxidant effects. *Abutilon indicum,* a predominant species found extensively in tropical and subtropical regions, particularly thrives in India, Bangladesh, and Iraq[1]. This plant's herbal extract has antiproliferative, antibacterial[2], antioxidant, cytotoxicity against tumor cells[3,] and antiurolithiatic properties[4]. Therefore, the nephroprotective activity of *Abutilon indicum* is related to its antioxidant and anti-inflammatory properties[5].

Malvaceae plant belongs to a large genus scientifically designated as *A. indicum* known by various names in different countries such as Kanghi (Hindi), country mallow

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(English), thuthi (Tamil), and atibala (Sanskrit)[6]. This plant is associated with several potent therapeutic drugs, including aminoglycoside antibiotics and NSAIDs. These therapeutic agents possess the potential to safeguard the kidneys, preventing conditions like acute renal failure, chronic interstitial nephritis, and nephritic syndrome[7]. Plants like yerba mate, hibiscus, chamomile, lemongrass, fennel, and menthe contain some pharmacologically important chemicals[8], as evidenced by the chemical structure of *A. indicum*. These chemicals include alkaloids, saponins, phenolic compounds, flavonoids, glycosides, proteins, steroids, and essential oils[9]. The plant's seeds, roots, and leaves have all been widely utilized to cure many ailments[4,9]. *A. indicum* is an alternative source of therapies that treat nephrotoxicity and kidney damage. *Abutilon indicum* is an alternative source of therapies for nephrotoxicity and kidney problems caused by physical heat stress[10]. Severe physiological dysfunction caused by heat stress can lead to illnesses, such as cancer, diabetes mellitus, and coronary artery disease in humans and animals. Heat stress directly impacts immune system cells, decreasing the number of practical cells[11]. Moreover, heat stress caused damage to substantially all biological systems[12]. Different cells and organs are altered metabolically and functionally by high ambient temperature[13]. Heat stress raises the chance of developing acute kidney disease[14]. Acute tension also reduces renal blood flow, resulting in ischemia and acute organ damage[15]. Rat kidneys have been protected by *A. indicum* when exposed to heat[16]. Since the kidneys consume adenosine triphosphate at a rapid rate[17]. However, acute kidney injury was more prone to have a significant inflammatory response to endotoxins[18].

Therefore, the current study aimed to evaluate the effects of the aqueous extract of *A. indicum* on rats with heat-stress kidney damage.

2. Materials and Methods

2.1. Ethical approval

This study was approved by the research and animal ethical committee in the College of Veterinary Medicine, AL-Muthanna University, Iraq.

2.2. Preparation of Aqueous Plant Extract

The whole plant of *A. indicum* seeds, roots, and leaves were accumulated at the Al-Muthanna University, Iraq, and identified in the Botany branch. The components of the *A. indicum* were cleaned with tap water, rinsed three times with sterile distilled water, and then allowed to air dry. The plants were divided into pieces and allowed to air dry for a week at room temperature. Later, the plant was processed to create the fine powder[19]. On a hot plate with starring, 10 g of plant powder was dissolved in 100 ml of distal water overnight. Later, filter paper was used to filter the solution (what-man No .1). Following a 10-minute centrifugation of the extract at 3000 rpm, the filtrate was transferred to a clean bottle and stored there until needed.

2.3. Study design

Male albino rats with an average weight of 200 ± 20 g that were 8 weeks old were purchased from the animal hospital, College of Veterinary Medicine, AL-Muthanna University, Iraq. All animals were kept in conventional conditions, and fed a pellet diet (Hindustan lever Ltd. Bangalore), containing a minimum of 16% crude protein, and metabolizable energy values of 8.5 MJ/Kg. They were given unrestricted access to water. The animals were randomly divided into three treatment groups, each group of 10 rats. The first group (GI) was given orally every other day for 28 days with normal saline (0.9% NaCl). The second group (GII) was exposed to heat stress (40°C elevation for 5 hours per day using electric heaters and 75-85% humidity for 5 hours per day (12.00-03.00 pm) for the 4 weeks without eating or drinking overnight (12 hours)[20]. The third group (GIII) received 400 mg/kg body weight of *A. indicum* extract for 28 days after being subjected to heat and humidity stress.

2.4. Blood Collection and Preparation

The animals were anesthetized with chloroform vapor at approximately 25,000 ppm for 5 minutes[21] following the experimental procedure and subsequently euthanized. Rat males were provided for histological and biochemical examinations, and 5 ml blood samples were obtained by cardiac puncture with disposable syringes and stored in tubes without anticoagulant even as waiting for a clot to appear within 15 minutes[7]. Centrifugation was then used to isolate the serum from the coagulated blood samples for 15 minutes at 5000 rpm. The serum was stored in standard tubes and kept at -20°C until necessary[22].

2.5. Biochemical Parameters

Blood urea was measured using a colorimetric-enzymatic mechanism based on urease action, which hydrolyzes urea in ammonium ions carbon dioxide product. This coloration was detected at 600 nm and was corresponding to the urea concentration in the serum sample[23]. The evolution of serum creatinine was predicated on changes in the original picrate reaction. Creatine reacted with picrate ions in an alkaline condition, forming a creatinine picric acid complex. The increase in absorbance over a predetermined period of time was used to calculate the concentration of creatinine in the samples, which was based on the color complex density[24].

2.6. Histological examination

Slices of two kidneys were taken from 10 male rats in each group and fixed in 10% formalin for 24 hours for histopathological investigations. Later, the Histokinette was used to process the specimens as part of regular procedures[25]. The cells were then stained regularly with hematoxylin and eosin (H & E) and inspected under a light

microscope.

2.7. Statistical analysis

The IBM SPSS (USA) program, version 20, was used to identify the least significant difference (LSD) between groups using an ANOVA one-way test. P value ≤ 0.05 was considered statistically significant. The numbers on the tables correspond to average means and standard deviations.

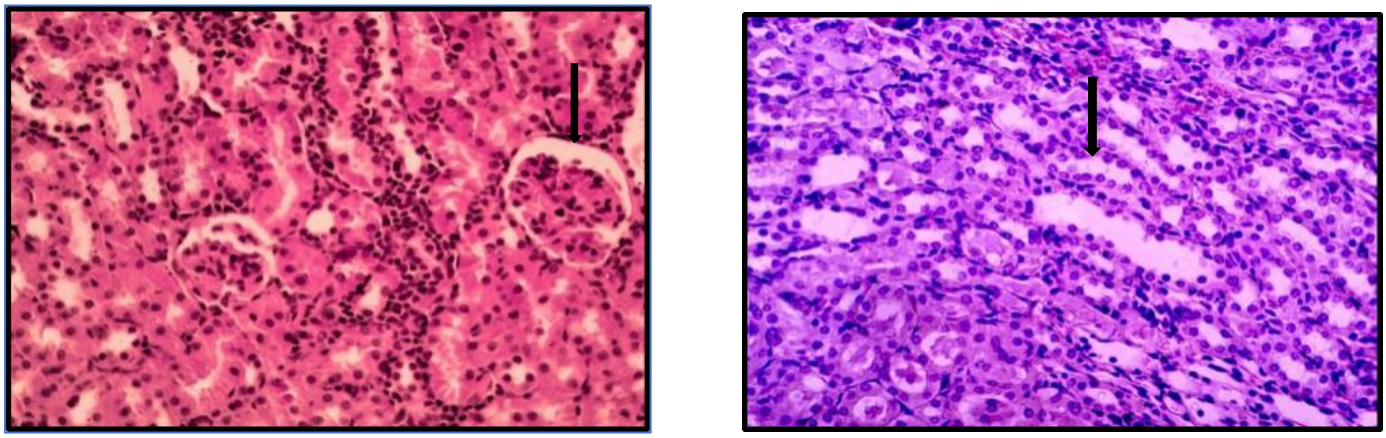
3. Results

Animals in the control group (GI) revealed normal biochemical parameters in urea and creatinine, while animals in the GII indicated elevated urea and creatinine by 107.62 ± 1 and 2.65 ± 0.3, respectively (Table 1). There was an increase in urea and creatinine values in the GIII group, with mean values of 82. 6 ± 2 and 1.21 ± 0.2, respectively (Table1). The histopathological observation of the kidneys for the non-stress rats (GI) showed normal kidney tissues with normal glomerulus. The proximal and distal convoluted tubules were demonstrated without any inflammatory or pathological changes (Figure 1). In the GII group, the histological image of the kidneys of male rats under heat stress indicated glomerulolysis and atrophy with capsular space dilation (Figure 2).

Table 1. Biochemical tests (blood urea and creatinine) for different experimental groups

Parameters (mg/dl)	GI (non-heat)	GII (heat stress)	GIII (heat stress treatment + *AI*)
Creatinine	0.97±1[a]	2.65±0.3 [b]	1.21±0.2 [c]
Urea	60.66±1.2[a]	107.62±1[b]	82. 6±2[c]

[a, b, c] means different superscript letters in the same row show significant differences compared to the control (p ≤ 0.05). AI: *Abutilon indicum*



(A) (B)

Figure 1. The normal histological section of the cortical part (A) and Medulla part (B) of the rats' kidneys for the non-stress rats (H & E, 10X).

The examination revealed evidence of the edema and hyperemia changes, along with the necrotic cells, generally observed in rat kidneys with pathologic change. However, GIII treatment, including 400 mg/kg body weight of aqueous plant extract, showed a decrease in capillary congestion, tubular damage, and glomerular malformation, with the severity of pathological damage reduced, compared to GII (Figure 3).

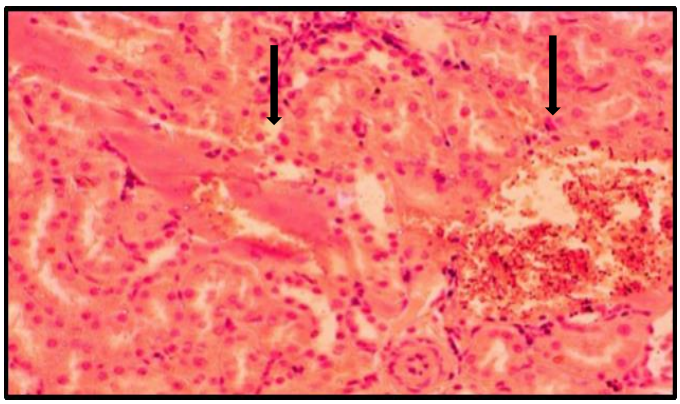


Figure 2. The histological section of the kidney tissue in stressed rats of group II indicates the edema and hyperemia changes of the collecting tubules (H & E, 10X)

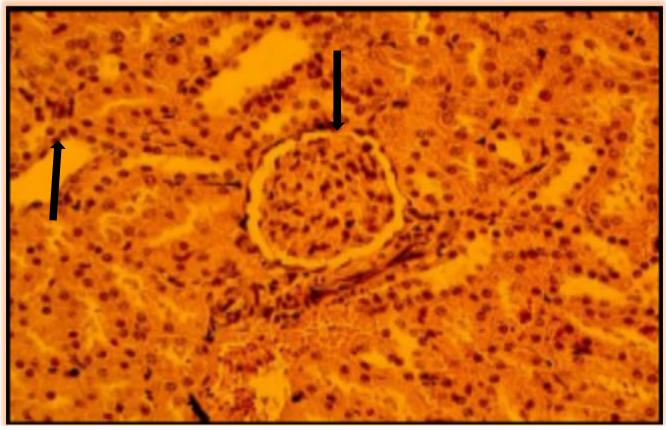


Figure 3. The histological section of the kidney tissue (cortical part) in Group III, including stressed rats treated with *Abutilon indicum* at 400 mg/Kg body weight, reveals a decrease in cellular damage and demonstrates inflammatory cell infiltration (H & E, 10X)

4. Discussion

Abutilon indicum has high antioxidant activity in the treatment of urinary disorders[26]. According to some authors, physical stress from the heat may harm kidneys[27]. The administration of *A. indicum* extract at a dosage of 400 mg/kg indicated a significant

improvement in the biochemical parameters of blood urea and serum creatinine in the GIII group, compared to GII, which was exposed to heat stress. Serum creatinine concentration is the most widely used indicator of kidney function. The creatinine level in the blood rises when the kidney does not work properly[28]. A significant increase in the amount of blood urea in the GII group is a good predictor of kidney disorder and nephrotoxicity, consistent with previous studies[29,30]. The aqueous extract of *A. indicum* did not contain an apparent toxic dose to the kidneys of the laboratory rats[31]. Obviously, *A. indicum* is an effective, well-tolerated preventive over-the-counter drug for kidney injury[32]. Thus, prolonged use or exposure to heat stress is commonly associated with kidney injury in animals[30]. In this study, the results of histological examination showed clear evidence of histological abnormalities. There was a statistically significant reduction in the incidence and severity of kidney injury produced in experimental models after administration of *Abutilon indicum* at a dose of 400 mg/kg[4]. These findings agree with the work of other researchers indicating that heat stress causes negative changes in renal corpuscles, proximal and distal convoluted tubules of the renal cortex[33]. Moreover, it was found that serum creatinine and blood urea are both connected to histological findings when determining renal function[32]. Heat stress stimulates free radicals, leading to oxidative damage in organs such as liver, heart, brain, and kidneys[21,22].

Phenol, a compound found in herbal plants, exhibits a supportive effect on kidney disorders and possesses anti-inflammatory and antioxidant properties[34]. Specifically, phenol is recognized for its role in mitigating kidney disorders and functioning as an anti-inflammatory agent. In the context of renal protection, the first line of defense involves endogenous, factors, while secondary damages, such as prerenal and postrenal factors, are mitigated by substances that alleviate the underlying disease or condition[35]. However, the lack of renal impairment has provided supportive evidence for its antioxidant properties with the high flavonoids, fatty acids, and mucilage in this plant building[36].

5. Conclusion

This study highlights the pharmacological evidence of *Abutilon Indicum* to treat kidney damage. This herbal plant was found to be safe and nontoxic when administrated orally to laboratory animals at a dose of 400 mg/kg/body weight. In addition, exposure to heat stress had a series of histopathological and biochemical effects leading to kidney disease in living organisms. Finally, more scientific knowledge needs to be implemented into the new alternative medicine.

Declarations

Competing interest

The authors declare no conflict of interest.

Authors' contribution

Ghasaq Sami Mshary, MunaTawfeeq Abd, Bassim Abdullah Jassim designed the study Ghasaq Sami Mshary and MunaTawfeeq Abd involving field data collection. Bassim Abdullah Jassim is statistically analyzed the data also interpreted the results and wrote the first draft of the manuscript. Ghasaq Sami Mshary revise the final versions. All authors have read and approved the final manuscript.

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Availability of data and materials

Data are included within the article.

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Ethical consideration

The authors declare that the article was originally written, and all data remain from the present experimental study. The article is not submitted or published partially or even totally in print or online format in any publications.

References

1. Ojezele MO, and Abatan OM. Toxicological effects of chloropyrifos and methidathion in young chickens. Afr J Biochem Res. 2009; 3(3): 48-51. Available at: https://academicjournals.org/journal/AJBR/article-full-text-pdf/CD195C610418.pdf
2. Singh R, and Mendhulkar V. *Abutilon indicum* (Linn.) sweet leaves, a natural source of saponin: A spectrophotometric assay. Int J Pharm Tech Res. 2015; 8(4): 725-729. Available at: https://sphinxsai.com/2015/ph_vol8_no4/2/(725-729)V8N4PT.pdf
3. Abdul Rahuman A, Gopalakrishnan G, Venkatesan P, and Geetha K. Isolation and identification of mosquito larvicidal compound from *Abutilon indicum* (Linn.) Sweet. Parasitol Res. 2008; 102: 981-988. Available at: https://link.springer.com/article/10.1007/s00436-007-0864-5
4. Pullaiah CP, GV NK, Madhuri PVR, Dhanunjaya S, Ranganayakulu D, and Kumari BP. Supplementation of ethanolic extract of *Abutilon indicum* (L) sweet prevents urolithiasis in experimental rats. Int J Pharmacomet Integr Biosci. 2016; 1(1): 7-13. Available at: https://www.scienztech.org/index.php/ijpib/article/view/929
5. Thakor P, Mehta JB, Patel RR, Patel DD, Subramanian RB, and Thakkar VR. Extraction and purification of phytol from *Abutilon indicum*: Cytotoxic and apoptotic activity. RSC Adv. 2016; 6(54): 48336-48345. Available at: https://pubs.rsc.org/en/content/getauthorversionpdf/c5ra24464a
6. Mohite MS, Shelar PA, Raje VN, Babar SJ, and Sapkal RK. Review on pharmacological properties of *Abutilon indicum*. Asian J Pharm Res. 2012; 2(4): 156-160. Available at: https://www.indianjournals.com/ijor.aspx?target=ijor:ajpr&volume=2&issue=4&article=008
7. Shanmugapriya S, Anuradha R, Kiruthika R, Venkatalakshmi P, and Velavan S. Formulation and evaluation of *Abutilon indicum* and Boerhaavia diffusa for the determination of nephroprotective activities. J Sc Trans Environ Technov. 2015; 9(2): 101-106.

8. Valduga AT, Gonçalves IL, Magri E, and Finzer JR. Chemistry, pharmacology, and new trends in traditional functional and medicinal beverages. Food Res Int. 2019; 120: 478-503. DOI: 10.1016/j.foodres.2018.10.091
9. Nirmal CR, Ebenezer RS, Kannan P, Balasubramanian M, Thirunavukkarasu I, Mondal R, et al. Anti-tuberculosis activity of bio-active compounds from *Lantana camara* L., *Euphorbia hirta* L., *Mukia maderaspatana* L. *M. Roem*, and *Abutilon indicum* (L.). Eur J Integr Med. 2020; 35: 101105. DOI: 10.1016/j.eujim.2020.101105
10. Dodd KT, Mundie TG, Lagutchik MS, and Morris JR. Cardiopulmonary effects of high-impulse noise exposure. J Trauma Acute Care Surg. 1997; 43(4): 656-666. DOI: 10.1097/00005373-199710000-00016
11. Kamwanja LA, Chase Jr CC, Gutierrez JA, Guerriero Jr V, Olson TA, Hammond AC, et al. Responses of bovine lymphocytes to heat shock as modified by breed and antioxidant status. J Ani Sci. 1994; 72(2): 438-444. DOI: 10.2527/1994.722438x
12. Leon LR, and Helwig BG. Heat stroke: Role of the systemic inflammatory response. J Appl Physiol. 2010; 109(6): 1980-1988. DOI: 10.1152/japplphysiol.00301.2010
13. Rebez EB, Sejian V, Silpa MV, and Dunshea FR. Heat stress and histopathological changes of vital organs: A novel approach to assess climate resilience in farm animals. Sustainability. 2023; 15(2): 1242. DOI: 10.3390/su15021242
14. Alayyannur PA, and Ramdhan DH. Relationship of heat stress with acute kidney disease and chronic kidney disease: A literature review. J Public Health Res. 2022; 11(2): 1-7. DOI: 10.1177/22799036221104149
15. Devarajan P. Update on mechanisms of ischemic acute kidney injury. J Am Soc Nephrol. 2006; 17(6): 1503-1520. DOI: 10.1681/asn.2006010017
16. Zuhl M, Schneider S, Lanphere K, Conn C, Dokladny K, and Moseley P. Exercise regulation of intestinal tight junction proteins. Br J Sports Med. 2014; 48(12): 980-986. DOI: 10.1136/bjsports-2012-091585
17. Chen B, Yang B, Zhu J, Wu J, Sha J, Sun J, et al. Hsp90 relieves heat stress-induced damage in mouse kidneys: Involvement of antiapoptotic PKM2-AKT and autophagic HIF-1α signaling. Int J Mol Sci. 2020; 21(5): 1646. DOI: 10.3390/ijms21051646
18. Salimi S, Shardell MD, Seliger SL, Bandinelli S, Guralnik JM, and Ferrucci L. Inflammation, and trajectory of renal function in community-dwelling older adults. J Am Geriatr Soc. 2018; 66(4): 804-811. DOI: 10.1111/jgs.15268
19. Krisanapun C, Peungvicha P, Temsiririrkkul R, and Wongkrajang Y. Aqueous extract of *Abutilon indicum* sweet inhibits glucose absorption and stimulates insulin secretion in rodents. Nutrition Research. 2009; 29(8): 579-587. DOI: 10.1016/j.nutres.2009.07.006
20. Mshary GS, and Kadhim ZY. Evaluation of hematological and biochemical parameters of the heat-stress rats treated with *Abutilon indicum* aqueous extract. Mirror Res Vet Sci Anim. 2017; 6(3): 25-31. Available at: https://doaj.org/article/e7251fbd35ec4abb91144820fa2395d2
21. National Research Council (NRC). Acute exposure guideline levels for selected airborne chemicals, Volume 12. 2012.
22. Abed HA, Kadhem HK, and Bayram D. Histopathological and biochemical study on the kidneys of male mice injected intraperitoneally with thioacetamide. Iraqi J Sci. 2023; 64(1): 13-19. Available at: https://www.iasj.net/iasj/download/b968f78703beea1f
23. Fakhoury-Sayegh N, Trak-Smayra V, Khazzaka A, Esseily F, Obeid O, Lahoud-Zouein M, et al. Characteristics of nonalcoholic fatty liver disease induced in wistar rats following four different diets. Nutr Res Pract. 2015; 9(4): 350-357. Available at: https://synapse.koreamed.org/upload/synapsedata/pdfdata/0161nrp/nrp-9-350.pdf
24. Doumas BT. The evolution of clinical chemistry as reflected in textbooks published in the United States. Clin Chem. 1998; 44(11): 2231-2233. DOI: 10.1093/clinchem/44.11.2231
25. Razooki SM, and Rabee AM. Evaluation of the toxicological effects of zinc oxide nanoparticles in albino male mice. Iraqi J Sci. 2020: 61(1): 42-58. Available at: https://www.iasj.net/iasj/download/d19b63e27b68704d
26. Mshary GS, Khudhur HB, and Al-Yasari A. Activity of saponin in the parts of the medicinal plant *Abutilon indicum*. Am J Biomed. 2020; 9(1): 55-61. DOI: 10.18081/2333-5106/021-01-55-61
27. Yang CY, and Lin MT. Oxidative stress in rats with heatstroke-induced cerebral ischemia. Stroke. 2002; 33(3): 790-794. DOI: 10.1161/hs0102.100208
28. Schlader ZJ, Hostler D, Parker MD, Pryor RR, Lohr JW, Johnson BD, et al. The potential for renal injury elicited by physical work in the heat. Nutrients. 201; 11(9): 2087. DOI: 10.3390/nu11092087
29. Pandya D, Nagrajappa AK, and Ravi KS. Assessment and correlation of urea and creatinine levels in saliva and serum of patients with chronic kidney disease, diabetes, and hypertension–A research study. J Clin Diagnostic Res. 2016; 10(10): ZC58- ZC62. DOI: 10.7860%2FJCDR%2F2016%2F20294.8651
30. Stevens LA, and Levey AS. Measurement of kidney function. Med Clin. 2005; 89(3): 457-473. DOI: 10.1016/j.mcna.2004.11.009
31. Pingale SS, and Virkar PS. Evaluation of acute toxicity for *Abutilon indicum*. Der Pharmacia Lettre, 2011; 3(3) : 37-42. Available at: https://www.scholarsresearchlibrary.com/articles/evaluation-of-acute-toxicity-for-abutilon-indicum.pdf
32. Jacob Jesurun RS, and Lavakumar S. Nephroprotective effect of ethanolic extract of *Abutilon indicum* root in gentamicin induced acute renal failure. Int J Basic Clin Pharmacol. 2016; 5: 841-845. Available at: https://core.ac.uk/reader/543134430
33. Al-Tekrity SS. Effect of heat stress on histopathological alterations in kidneys of albino rats. Res Opi Anim Vet Sci. 2011; 1(2): 118-121. Available at: https://www.roavs.com/pdf-files/vol_2_2011/118-121.pdf
34. Javaid R, Aslam M, Nizami Q, and Javaid R. Role of antioxidant herbal drugs in renal disorders: An overview. Free Radic Antioxid. 2012; 2(1): 2-5. DOI: 10.5530/ax.2012.2.2
35. Tienda-Vázquez MA, Morreeuw ZP, Sosa-Hernández JE, Cardador-Martínez A, Sabath E, Melchor-Martínez EM, et al. Nephroprotective plants: a review on the use in pre-renal and post-renal diseases. Plants. 2022; 11(6): 818. DOI: 10.3390/plants11060818
36. Saremi J, Hasheminasab M, Sadeghi N, and Jahromi HK. Preventive and curative effects of aqueous extracts of *Descurainia sophia* L on nephrolithiasis induced in rats. Asian J Pharm. 2018; 12(1): S228-S233. DOI: 10.22377/ajp.v12i01.2066