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 indicum* 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 G1 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 40ºC 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 GII 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 GII group, compared to G1 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 Iraq¹. This plant's herbal extract has antiproliferative, antibacterial², antioxidant, cytotoxicity against tumor cells³, and antiurolithiatic properties⁴. Therefore, the nephroprotective activity of *Abutilon indicum* is related to its antioxidant and anti-inflammatory properties⁵.

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.
(English), thuthi (Tamil), and atibala (Sanskrit)⁵. 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 syndrome⁶. Plants like yerba mate, hibiscus, chamomile, lemon grass, fennel, and menthe contain some pharmacologically important chemicals⁷, as evidenced by the chemical structure of *A. indicum*. These chemicals include alkaloids, saponins, phenolic compounds, flavonoids, glycosides, proteins, steroids, and essential oils⁸. The plant’s seeds, roots, and leaves have all been widely utilized to cure many ailments⁹. *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.⁹. 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 cells¹⁰. Moreover, heat stress caused damage to substantially all biological systems¹¹. Different cells and organs are altered metabolically and functionally by high ambient temperature¹². Heat stress raises the chance of developing acute kidney disease¹³. Acute tension also reduces renal blood flow, resulting in ischemia and acute organ damage¹⁴. Rat kidneys have been protected by *A. indicum* when exposed to heat¹⁵. Since the kidneys consume adenosine triphosphate at a rapid rate¹⁶. However, acute kidney injury was more prone to have a significant inflammatory response to endotoxins¹⁷.

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 powder¹⁹. On a hot plate with stirring, 10 g of plant powder was dissolved in 100 ml of distilled 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). 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 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. 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.

#### 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. 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.

#### 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. 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 (Table 1). The numbers on the tables correspond to average means and standard deviations.

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).

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).

4. Discussion

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

![Figure 1](image1.png)

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).

![Figure 2](image2.png)

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](image3.png)

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).

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

<table>
<thead>
<tr>
<th>Parameters</th>
<th>GI (non-heat)</th>
<th>GII (heat stress)</th>
<th>GIII (heat stress treatment + AI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Creatinine</td>
<td>0.97±1a</td>
<td>2.65±0.3b</td>
<td>1.21±0.2c</td>
</tr>
<tr>
<td>Urea</td>
<td>60.66±1.2a</td>
<td>107.62±1b</td>
<td>82.6±2c</td>
</tr>
</tbody>
</table>

a, b, c means different superscript letters in the same row show significant differences compared to the control (p ≤ 0.05). AI: Abutilon indicum
improvement in the biochemical parameters of blood urea and serum creatinine in the GII 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. 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. The aqueous extract of *A. indicum* did not contain an apparent toxic dose to the kidneys of the laboratory rats. Obviously, *A. indicum* is an effective, well-tolerated preventive over-the-counter drug for kidney injury. Thus, prolonged use or exposure to heat stress is commonly associated with kidney injury in animals. 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. These findings agree with the work of other researchers indicating that heat stress causes negative changes in renal corporles, proximal and distal convoluted tubules of the renal cortex. Moreover, it was found that serum creatinine and blood urea are both connected to histological findings when determining renal function. Heat stress stimulates free radicals, leading to oxidative damage in organs such as liver, heart, brain, and kidneys.

Phenol, a compound found in herbal plants, exhibits a supportive effect on kidney disorders and possesses anti-inflammatory and antioxidant properties. 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. 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.

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, MunatWafeeq Abd, Bassim Abdullah Jassim designed the study Ghasaq Sami Mshary and MunatWafeeq 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.

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