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Alhagi maurorum Leaf Extract restricts demethylation - convinced kidney injury in rats through inflection of extirpative pressure and histopathological changes

Nitin Kumar, Heera Lal Sharma

Department of Basic and Applied Science, Sangam university, Bhilwara, India

Objectives: The present study elucidates the prospective protective effect of *A. maurorum Leaf* aqueous extract used for demethylation, a triazole fungicide beside nephrotoxicity induced by, in the kidney of the rats.

Methods: Adult Wistar rats were exposed either to demethylation (67 mg/kg body weight), or to *A. maurorum Leaf* extract (300 mg/kg body weight) or to their consolidation. demethylation was execute by intra-peritoneal injection each 2 days from day 7 until day 15, the forfeit day, although *A. maurorum Leaf* extract was execute every day by gavage during 15 days. Oxidative pressure parameters, histopathological examination and kidney biomarkers were determined.

Results: *A. maurorum Leaf* extract execute to demethylation treated rats decreased kidney levels of protein carbonyls (PCOs, -11%), malondialdehyde (-10%), hydrogen peroxide (-12%), and advanced oxidation protein products (AOPP, -16%); antioxidant enzyme activities: superoxide dismutase (-8%) and glutathione peroxidase (GPx, -14%), catalase (-13%), and the levels of non-enzymatic antioxidants: metallothionein (-12%) and non-protein thiols (-9%), glutathione (-7%). Moreover, this leaf extract prohibited biomarker changes by reducing plasma levels of urea, uric acid, creatinine, and LDH and ever-increasing those of GGT and ALP. demethylation (glomeruli fragmentation of Histopathological alterations induced, Bowman's space enlargement, tubular epithelial cells necrosis and infiltration of inflammatory leucocytes) were attenuated following *A. maurorum*.

Conclusions: Our outcome indicated that *A. maurorum Leaf* extract had protective effects beside demethylation -induced kidney injury, which could be attributed to its phenolic compounds.

Table 4.

Plasma ALP, GGT and LDH activities and kidney LDH activity in control and treated rats with demethylation (DMI), *A. maurorum* aqueous extract (AMR) or their combination (AMR + DMI).

Parameters and Treatments	Controls	DMI	AME+DMI	AME
Plasma				
ALP (IU/L)	122.5 ± 13.65	95.42 ± 5.94**	103.08 ± 5.60**	112.67 ± 5.49
GGT (IU/L)	11.50 ± 1.75	7.44 ± 0.50***	9.52 ± 0.84****	12.30 ± 2.43
LDH (IU/L)	1162.33 ± 97.84	1824.17 ± 94.96***	1274.67 ± 89.08****	1312.00 ± 21.43**
Kidney				
LDH (IU/L)	3.37 ± 0.29	2.63 ± 0.23***	2.97 ± 0.29**	3.27 ± 0.22

Values are means ± SD for six rats in each group. ALP: alkaline phosphatase, GGT: gamma glutamyltranspeptidase, LDH: Lactate dehydrogenase. DMI, AME + DMI and AME groups vs. control group: * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$. AMR + DMI group vs DMI group: # $p < 0.05$. ### $p < 0.001$.

Table 5.

MDA, H₂O₂, PCO, AOPP, NPSH, GSH and MT levels in control and treated rats with demethylation (DMI), *A. maurorum* leaf extract (AME) or their combination (AME + DMI).

Parameters and Treatments	Controls	DMI	AME+DMI	AME
MDA (nmol/g tissue)	142.75 ± 9.63	238.01 ± 18.62***	213.81 ± 15.14****	147.22 ± 16.49
H ₂ O ₂ (nmol/mg protein)	0.042 ± 0.004	0.064 ± 0.005***	0.056 ± 0.005****	0.045 ± 0.004
PCO (nmol/mg protein)	0.59 ± 0.05	0.84 ± 0.05***	0.75 ± 0.06****	0.56 ± 0.05
AOPP (nmol/mg protein)	0.20 ± 0.02	0.37 ± 0.02***	0.31 ± 0.01****	0.21 ± 0.02
NPSH (μmol/g tissue)	2.40 ± 0.12	2.76 ± 0.05***	2.50 ± 0.04****	2.47 ± 0.07
GSH (μg/g tissue)	29.74 ± 1.45	34.05 ± 2.30**	31.55 ± 1.08**	30.86 ± 0.71
MT (μmol GSH/g tissue)	0.49 ± 0.01	0.57 ± 0.06**	0.50 ± 0.03*	0.47 ± 0.04

Values are means ± SD for six rats in each group. MDA: malondialdehyde, H₂O₂: hydrogen peroxide, PCO: protein carbonyls, AOPP: advanced oxidation protein products, NPSH: non-protein thiols, GSH: reduced glutathione MT: metallothionein. DMI and AMI + DMI groups vs. control group: * $p < 0.05$. ** $p < 0.01$. *** $p < 0.001$. AME + DMI group vs DMI group: # $p < 0.05$. ### $p < 0.001$.

Table 6.

Grading of the histopathological changes in the kidney sections.

Groupes	Enlarged Bowman'sspace	Glomeruli fragmentation	Necrosis of the epithelial cells lining the tubules	Infiltration ofleucocytes
Controls	-	-	-	-
DMI	++	+++	+++	+++
AME + DMI	-	-	+	-
AME	-	-	-	-

Scoring was done as follows: none (-), mild (+), moderate (++) and severe (+++).

Table 1.

Mineral content of *Alhagi maurorum*

Leaf Extract	
Minerals	Concentration (Mg/100g <i>A. maurorum</i> Leaf weight)
Mg ²⁺	54.69
Na ⁺	410.82
Ca ²⁺	101.82
Fe ²⁺	6.78
Cu ²⁺	0.322

Table 2. Body, absolute and relative kidney weights. Food and water intake of control and treated rats with demethylation (DMI), *A. maurorum* aqueous extract (AME), or their combination (AME + DMI).

Parameters and Treatments	Controls	DMI	AME + DMI	AME
Initial body weight (g)	248.67 ± 8.48	249.67 ± 5.61	251.67 ± 4.27	254.17 ± 6.43
Final body weight (g)	261.00 ± 6.81	264.33 ± 5.20	262.00 ± 4.86	267.67 ± 9.18
Absolute kidney weight (g)	1.61 ± 0.15	1.68 ± 0.10	1.61 ± 0.06	1.76 ± 0.17
Relative kidney weight (g/100g bw)	0.62 ± 0.05	0.63 ± 0.03	0.61 ± 0.02	0.66 ± 0.05
Food intake (g/day/rat)	16.68 ± 1.59	16.08 ± 1.77	15.89 ± 1.55	16.39 ± 1.42
Water intake (mL/day/rat)	25.47 ± 2.45	33.16 ± 2.64***	26.07 ± 2.22***	26.03 ± 1.64

Values are means ± SD for six rats in each group. bw: body weight. DMI group vs. control group: ****p* < 0.001. AME + DMI group vs DMI group: ###*p* < 0.001.

Table 3.

Urinary volume, creatinine clearance, plasma and urinary levels of creatinine, urea and uric acid, and BUN of control and treated rats with demethylation (DMI), *A. maurorum* aqueous extract (AME) or their combination (AME + DMI).

Parameters and Treatments	Controls	DMI	AME+DMI	AME
Urinary volume (mL/24 h)	5.33 ± 0.41	14.00 ± 1.87***	11.67 ± 0.41****	7.67 ± 1.08***
Creatinine clearance (µL/min)	536.75 ± 81.31	339.58 ± 39.50***	533.28 ± 88.10***	640.26 ± 83.20*
Creatinine (µmol/L)				
Plasma	52.40 ± 3.12	62.62 ± 6.12**	54.67 ± 4.86*	54.34 ± 0.96
Urine	7551.25 ± 573.05	2216.67 ± 440.08**	3580.63 ± 526.25****	6550.00 ± 39.53*
Urea (mmol/L)				
Plasma	5.82 ± 0.39	9.35 ± 0.48***	7.38 ± 0.25****	6.49 ± 0.23**
Urine	472.61 ± 66.84	161.22 ± 9.60**	234.16 ± 31.28****	359.57 ± 19.09**
Uric acid (µmol/L)				
Plasma	73.13 ± 6.04	120.71 ± 9.60**	64.53 ± 5.30***	76.93 ± 3.70
Urine	247.50 ± 39.47	131.67 ± 14.72***	147.5 ± 7.58***	215.00 ± 30.17
BUN ^a (mmol/L)	2.72 ± 0.18	4.37 ± 0.22***	3.45 ± 0.12****	3.06 ± 0.11**

Values are means ± SD for six rats in each group. BUN: blood urea nitrogen. BUN was calculated using the formula conversion: BUN (mmol/L) = [urea(mmol/L)]/2.14. DMI, AME + DMI and AME groups vs. control group: **p* < 0.05. ***p* < 0.01. ****p* < 0.001. AME + DMI group vs DMI group: #*p* < 0.05. ##*p* < 0.01. ###*p* < 0.001.