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التأثيرات الغذائية والعلاجية المحتملة لأوراق وقرون البونسيانا على حيوية الكلى في الفئران المصابة بالفشل الكلوي

Potential Nutraceutical and Therapeutic Effects of Delonix Regia Leaves and Pods on Kidneys Vitality in Rats Inflicted With Renal Failure

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Abstract:

The incidence and prevalence of kidney failure had been increased recently and in addressing the global burden with high financial consequences even not only in developing countries but also in developed ones. This investgation aimed to explore the nutraceutical and therapeutic effects of delonix regia leaves and pods on kidneys vitality in rats inflicted with renal failure. Thirty-five male albino rats weighing 150±10g were divided into five equal groups (n=7 rats); one group kept as control negative (C -ve), while the rest four groups injected via intra-peritoneal by gentamicin at a dose of 100 mg/kg b. wt., for 7 days to induce renal failure, one group left as control positive (C +ve), while the other three groups fed on 5% of the diet of delonix regia pods, leaves and mixture of them each, for 45 consecutive days. At the end of experiment, body weight gain, food intake and feed efficiency ratio were calculated, Moreover, kidney functions (creatinine, urea and uric acid), triglycerides (T.G), total cholesterol (T.C), high density lipoprotein (HDLc), low denisty lipoprotein (LDLc), very low denisty lipoprotein (VLDLc), total protein, and liver enzymes Asparate transaminase (AST) and Alanine transaminase (ALT) were confirmed, as soon as kidneys histopathological examination. The obtained data showed that all rats fed on 5% of the diet of delonix regia pods, leaves and mixture of them each showed significant decrease in body weight gain, feed efficiency ratio, kidney functions, triglycerides, total cholesterol, low denisty lipoprotein, very low denisty lipoprotein and liver enzymes but significant increase in total protein and high density lipoprotein, furthermore, an improvement in kidneys histopathological examinations were occured. This study revealed that delonix regia had positive nutraceutical effects on kidneys vitality in rats inflicted with renal failure. Moreover, enhancing liver function, lipids profile and histological investigation for rats inflicted with renal faliure.

Key words: *Renal failure, delonix regia, rats, histological examination.*

Introduction

The incidence of renal failure had increased in recent times and in the treatment of the global burden. Meanwhile, Kidney disease is a major health concern with major financial consequences even in the developed world. This disease is increasingly prevalent due to risk factors such as high blood pressure and type 2

diabetes with the highest rates of chronic kidney disease in Africa. (**Ojo, 2014 and Mills *et al*., 2015**).

Delonix regia which known as the royal poinciana or flamboyant, is a species of flowering plants in the pea family, *Fabaceae*. It is widely cultivated as an ornamental tree in tropical regions, such as Taiwan, India, Vietnam, Malaysia, and the central region of South America. In some countries, *D. regia* is used as a folk medicine to treat certain disorders, such as constipation, inflammation, rheumatoid arthritis, diabetes, pneumonia, and malaria **(Fatmawaty and Astuti 2013 and Singh and Kumar 2014).** *Delonix regia* (DR) It is a plant used in traditional medicine and a natural product to treat various diseases such as diabetes, heart and kidney diseases. This plant is native to Africa and was introduced to Pakistan, and is cultivated as an ornamental tree found in most tropical regions of the world. The leaves of the plant contain flavonoids, alkaloids, terpenes, proteins, tannins, glycosides, sterols, triterpenoids, and polyphenols (**Abulude and Adejayan 2017**). Studies have shown that *delonix regia* leaves possess antimicrobial, anti-inflammatory and antioxidant properties which may be responsible for their curative use in folk medicine. (**Oyedeji *et al*. 2017**)

Moreover, *delonix regia* has wide applications in the medical field due to its anti-bacterial, anti-diabetic activity, and anti-inflammatory properties against various bacteria. Close contents such as percentage of moisture and percentage solubility in acids and alkalis play an important role while delivering medicinal ingredients to body parts **(AOAC. 1995 and Iroka, *et al*., 2014)**. *Delonix regia* is a leguminous plant that belongs to the Caesalpiniaceae family. The plant is rich in phytochemicals such as: saponins, alkalis, carotenoids, hydrocarbons, phytotoxins, flavonoids, tannins, steroids, carotenoids, galactomanone, lupeol, beta-sitosterol, terpenoids, glycosides and carbohydrates, essential acids and salts. Leaves, flowers, bark, and roots (**Ujowundu *et al*., 2008; Oyedeji *et al*., 2017).**

Furthermore, *delonix regia* leaves and roots contain many nutrients and phytochemicals that produce a specific physiological effect on the body of animals (**Alagbe *et al*., 2020**). Phytochemical components contain important pharmacological properties such as antimicrobial, anti-inflammatory, antifungal, antiviral, antioxidant, anticoagulant, anticoagulant, liver protective, antidiabetic, chemoprotective, and cytotoxic effects. **(Joy *et al*., 2019 and Manita and Gaurav, 2020)**.

Accordingly, this investgation aimed to explore the nutraceutical and therapeutic effects of *delonix regia* leaves and pods on kidneys vitality in rats inflicted with renal failure.

Materials and Methods

Materials

Plant collection and preparatio

The leaves and pods of royal poinciana (*delonix regia*) were collected from puplic parks and were taxonomically identified by botanist professor of Institute of Natural Products, College of Pharmacy, Cairo Medical University, egypt. Samples were washed twice with double distilled water, dried in the shade, then ground into a fine powder for further processing and used in 5% of the diet.

Gentamicin: Obtained from the El-Gomhoria Co, Cairo, Egypt.
Rats: Purchased from Cairo Food Technology Research Institute experimental animal station.

Methods

Biological experiments

Thirty-five male albino rats Sprague Dawley Strains weighing 150±10g were used in the experiment. All rats were housed individually in well-aerated cages and fed on basal diet for one week for adaptation. The basal diet consisted of 70% corn starch, 10% casein, 10% corn oil, 4% salt mixtureture, 1% vitamin mixtureture, and 5% cellulose, as recommended by **(AIN, 1993)**

Induction of renal failure in rats

Renal Failure was induced in normal healthy male albino rats via intraperitoneal injection of gentamicin at a dose of 100 mg /kg b. wt., for 7 days as described by **Farombi and Ekott (2006)**.

Experimental Design

Rats were divided into two main groups, the first main group (7 rats) fed on basal diet, all over the experiment period, as a control negative (control -ve). The second main group (28 renal failure rats) were divided into four groups (n=7 rats, where Renal failure control group (control +ve), and fed on basal diet, renal failure rats fed on basal diet + 5% royal poinciana (delonix regia) pods, renal failure rats fed on basal diet + 5% royal poinciana (delonix regia) leaves and renal failure rats fed on basal diet + 5% mixture of leaves & pods of royal poinciana (delonix regia) for 45 consecutive days.

During the experimental period, rats feeding was recorded every day and body weight was recorded every week. At the end of the experimental period, rats were fasted overnight before sacrificing. Blood sample were collected from aorta, in dry clean centrifuge tube, and left for 15 minutes to clot at room temperature, then centrifuged for 15 minutes at 3000 r.p.m for serum separation. Liver, spleen, heart,

lung and kidneys were removed, cleaned, weighed then the kidneys only saved in formalin solution 10% for histopathological examination.

Biological Evaluation

Body weight gain (BWG), food intake (FI) and feed efficiency ratio (FER) were calculated according to **Chapman *et al.*, (1959).** Using the following formulas:

BWG= Final weight – Initial weight

$$FER = \frac{\text{Gain in body weight (g)}}{\text{Food Intake (g)}}$$

Analytical methods

Serum creatinine, blood urea nitrogen (BUN) and uric acid levels, as markers of renal functions, were determined using the methods described by **Henry, (1974)**, **Patton and Crouch (1977)** and **Fossati *et al.*, (1980)**, respectively. Serum triglycerides (T.G) was determined according to **Fossati and Prencipe (1982),** total cholesterol (T.C) according to **Allen (1974)**, high density lipoprotein cholesterol (HDL-c) according to **Lopez (1997)** and low density lipoprotein cholesterol (LDL-c) according to **Lee and Nieman (1996)**. Finally, serum total protein was determined using the methods described by **Gornall *et al.*, (1949**) and serum liver enzymes (ALT, AST) were determined according to **Reitman and Frankel (1957**).

Histopathological Examination

kidneys specimens fixed in 10% neutral buffered formalin (pH=7.0), dehydrated in ethyl alcohol, then cleared in xylol and embedded in paraffin; 4-6 microns thickness sections prepared and stained with heamtoxylin and eosin for examining the liver using light microscope at various magnification **(Carleton, 1976).**

Statistical Analysis

Data were compared between the 5 groups by analysis of variance (ANOVA) using the procedure reported by (**Armitage and Berry, 1987).** The treatment means were compared using the least significant difference test (LSD) at a 5% level of probability, as reported by **(Waller and Duncan 1969)**.

Results and Discussion

Effect of *delonix regia* on BWG, FI and FER for renal failure rats

Body weight gain (BWG), food intake (FI) and feed efficiency ratio (FER) of control (-ve), control (+ve) and rats inflicted with renal failure then treated with of 5% of *delonix regia* pods, leaves and mixture of them are presented in Table (1).

Table (1): Effect of *delonix regia* on BWG, FI, and FER in rats inflicted with renal failure at the end of study

Parameters Animal group	BWG (g/45d)	FI (g/45d)	FER
Control (-)	24.60±0.19 d	31.43±1.43 d	0.78±0.025 a
Control (+)	31.00±1.23 a	43.42±2.91 b	0.71±0.031 b
Pods 5%	26.20±0.49 b	43.52±0.78 b	0.60±0.019 c
Leaves 5%	25.80±1.93 c	39.40±1.29 c	0.65±0.020 c
Mixture 5%	19.00±1.01 e	45.40±0.36 a	0.42±0.032 d

Values are means ± SD. Means with different superscript letters in the same column were significantly different at p≤0.05.

It could be cleared for rats injected with gentamicin without treatment (control +ve) group that BWG was 31.00±1.23 compared with 24.60±0.19 g/45 day in control (-ve) normal rats (P≤0.05), denoting significant decrease in BWG of control +ve compared with control -ve group. All rats injected with gentamicin then fed on 5% of *delonix regia* leaves, pods and the mixture of them showed significant decrease in BWG compared to control positive group. Regarding FI, there was significant increase in control +ve group compared to control -ve group. Moreover, there were significant decrease in *delonix regia* leaves 5% and mixture 5% groups but no significant of pods 5% group as compared to control positive group which were 39.40±1.29, 45.40±0.36, 43.52±0.78 and 43.42±2.91 g/45 days, respectively. Concerning FER, the mean values of control +ve were 0.71±0.031 but in control -ve was 0.78±0.025, indicating that there was significant decrease in FER in rats injected with gentamicin without treatment compared to normal rats. Meanwhile, all rats injected with gentamicin then treated with 5% *delonix regia* pods, leaves and mixture of them showed significant decrease in FER compared to not only control positive but also control negative group. Furthermore, there were no significant changes between 5% *delonix regia* leaves and pods groups in FER, and the mixture group showed the highest decrease in FER compared to all treated groups.

These results confirmed by the findings of These results were agreement with (**Payal *et al*., 2020**) who showed that there were non-significant changes observed in final body weight of Wistar rats treated with plant fruit extracts of *C. colocynthis* and *D. regia* in comparison to control treated vehicles. Mean while, **Alagbe *et al*., (2020**) revealed that *delonix regia* leaves and roots contain many nutrients and phytochemicals that produce a specific physiological effect on the body of animals. Furthermore, **Joy *et al*., (2019) and Manita and Gaurav (2020)** concluded that

delonix regia phytochemical components contain important pharmacological properties such as antimicrobial, anti-inflammatory, antifungal, antiviral, antioxidant, anticoagulant, anticoagulant, liver protective, antidiabetic, chemoprotective, and cytotoxic effects.

Effect of *delonix regia* on organs weight in renal failure rats

Data listed in Table (2) show the Effect of 5% *delonix regia* leaves, pods and mixture of them on organs weight of rats inflicted with renal failure.

Table (2): Effect of *delonix regia* on organs weight in rats inflicted with renal failure. at the end of study

Parameters Animal group	Liver g/bw	Kidneys g/bw	Heart g/bw	Spleen g/bw	Pancreas g/bw
Control (-)	2.88±0.01 d	0.71±0.02e	0.25±0.05 e	0.27±0.03 d	0.14±0.03 cd
Control (+)	5.27±0.03 a	0.95±0.04 a	0.43±0.06 a	0.41±0.05 a	0.20±0.05 a
Pods 5%	3.12±0.02 c	0.78±0.02 d	0.31±0.02 d	0.39±0.07 b	0.18±0.04 b
Leaves 5%	3.35±0.02 b	0.91±0.01 b	0.39±0.06 b	0.32±0.02 c	0.15±0.02 c
Mixture 5%	3.29±0.05 bc	0.88±0.03 c	0.34±0.02 c	0.28±0.06 d	0.14±0.06 cd

Values are means ± SD. Means with different superscript letters in the same column were significantly different at p≤0.05.

It is cleared from the table that all relative organs weights in control +ve group showed significant increase (P≤0.05) as compared to control -ve groups. All groups injected with gentamicin then fed on 5% *delonix regia* leaves, pods and the mixture of them showed significant decrease in all relative organ's weights compared to control positive groups. The highest significant decrease in relative liver, kidneys and heart weight were shown in the group orally injected with 5% *delonix regia* leaves compared to positive, while the highest significant decrease in relative spleen and pancreas weight were observed in 5% *delonix regia* leaves and mixture groups compared with positive groups.

These data were in agreement with **Azab *et al*., (2013)** who concluded that *delonix regia* extract not only possesses important anti-cancer effect but also has effective hepatic and antioxidant activities depending on dose due to the presence of flavonoids content. As soon as, seven major flavonoid glycosides including kaempferol3-rhamnoside (Afzelin), quercetin 3-rhamnoside, kaempferol 3-glucoide (astragalin), kaempferol 3-ruti-noside, kaempferol 3-neohesetperidos, (isocare) were also isolated.

Effect of *delonix regia* on kidney functions in renal failure rats

Therapeutic effect of 5% *delonix regia* leaves, pods and mixture of them on srum renal function (creatinine, urea and uric acid) of rats inflicted with Renal failure are recorded in table (3).

Table (3): Effect of *delonix regia* on serum creatinine, urea and uric acid in rats inflicted with renal failure at the end of study

Parameters Animal group	Creatinine (mg/dL)	Urea (mg/dL)	Uric acid (mg/dL)
Control (-)	0.86±0.09 c	61.60±1.64 c	2.36±0.03 de
Control (+)	1.02±0.09 a	69.00±2.51 a	3.20±0.09 a
Pods 5%	0.91±0.07 b	63.40±1.30 b	2.90±0.06 b
Leaves 5%	0.71±0.03 d	55.20±1.72 d	2.40±0.03 d
Mixture 5%	0.60±0.02 e	52.80±0.53 e	2.58±0.02 c

Values are means ± SD. Means with different superscript letters in the same column were significantly different at p≤0.05.

It is cleared from the table that there were significant increase in serum levels of creatinine, urea and uric acid in rats injected with gentamicin without treatment (control +ve) groups compared with normal rats (control -ve) which were 1.02±0.09, 69.00±2.51, 3.20±0.09, 0.86±0.09, 61.60±1.64 and 2.36±0.03 mg/dL, respectively. All rats orally injected with 5% *delonix regia* pods, leaves and mixture of them showed significant decrease in creatinine, urea and uric acid compared to control positive groups. The highest significant decrease in creatinine and urea serum levels were shown in group orally fed on 5% *delonix regia* mixture of leaves and pods, while in uric acid it was observed in the group orally fed with 5% *delonix regia* leaves as compared to control positive group.

These results confirmed by **Mauer *et al*., (1981**) who reported that high levels of creatinine in the blood and urea nitrogen in the blood are important signs of impaired kidney function which reflects a decrease in glomerular filtration rate. Meanwhile, **Ojo, *et al*., (2019)** who revealed that treatment with all concentrations of *delonix regia* extract reduced the increase of renal oxidative stress, and the three independent concentrations showed similar effects. This may be attributed to the antioxidants present in the leaf extract of *delonix regia* which may have increased the endogenous antioxidants or directly reduced the reactive oxygen species. This may have caused the glomerular filtration-induced nephrotoxicity. The effect of leaf extract may also be by inhibiting the generation of free radicals that may affect renal oxidative stress

and protect against cell damage caused by cisplatin. Furthermore, methanol extracts rich in alkaloid and flavonoids especially in leaves may be able to alleviate complications arising from nephrotoxicity caused by cisplatin. Furthermore, **Ojo, *et al*., (2019)** examined the effect of *delonix regia* leaves methanol extract on mouse models injected intraperitoneally with a single dose of 5 mg/kg cisplatin to induce nephrotoxicity. Concluding that suppression of mATPase activity, reduction of cytochrome c release and caspase-3 activation by *delonix regia* could be at least partially a mechanism for use in folk medicine in treating kidney disease.

Effect of *delonix regia* on lipid profiles in renal failure rats

The effect of *delonix regia* leaves, pods and mixture of them on triglycerides (T.G), total cholesterol (T.C), high density lipoprotein (HDL), low denisty lipoprotein (LDL) and very low denisty lipoprotein (VLDL) are listed in table (4).

Table (4): Effect of *delonix regia* on T.G., T.C., HDLc, LDLc and VLDLc in rats inflicted with renal failure at the end of study

Parameters Animal group	T.G (g/dL)	T.C (g/dL)	HDLc (g/dL)	LDLc (g/dL)	VLDLc (g/dL)
Control (-)	81.13±0.26 e	65.50±0.15 e	38.50±0.23 a	10.77±0.43 e	16.23±0.39 d
Control (+)	118.72±0.47 a	84.70±1.19 a	13.10±0.57 e	47.86±0.79 a	23.74±0.61 a
Pods 5%	98.34±0.13 b	82.90±0.24 b	19.77±0.29 d	43.46±0.28 b	19.67±1.09 b
Leaves 5%	89.26±0.27 d	73.10±0.32 d	36.45±0.17 c	18.80±0.99 d	17.85±0.39 c
Mix 5%	94.19±0.22 c	78.70±1.19 c	29.00±0.43 b	30.86±0.77 c	18.84±0.47 bc

Values are means ± SD. Means with different superscript letters in the same column were significantly different at p≤0.05.

It could be concluded from the table that all rats injected with gentamicin without treatment (C +ve) showed significant increase in serum levels of triglycerides (T.G), total cholesterol (T.C), low denisty lipoprotein (LDL) and very low denisty lipoprotein (VLDL) but significant decrease in high denisty lipoprotein (HDL) when compared to normal rats (C -ve). All rats injected with gentamicin then treated with orally administration with 5% *delonix regia* leaves, pods and the mixture of them showed significant decrease in triglycerides, total cholesterol, low denisty lipoprotein and very low denisty lipoprotein but significant increase in high denisty lipoprotein compared to control positive groups. Rats injected with gentamicin then orally treated with 5% *delonix regia* leaves showed the highest significant decrease in serum levels

of T.G, T.C, LDL and VLDL but highest significant increase in HDL compared to control positive groups.

These findings were in agreement **with Aloh *et al*., (2015)** who examined *delonix regia* methanol extracts using two doses (250 mg and 500 mg per kg body weight) for its effect on free radical scavengers and the lipid profile of albino rats. The results revealed that the mean HDL and LDL levels in both groups of mice did not differ significantly (P <0.05) at 250 mg but at 500 mg, the HDL level decreased significantly and the LDL remained stable. Regardless of dose, total cholesterol and triglyceride levels in the experimental mice did not differ from those in the controls, concluding that the *delonix regia* extract showed mild antioxidant effect and slightly elevated HDL and other bad fats. Meanwhile, **Middleton and Ea (1994**) demonstrated that *delonix regia* extract has superior cytotoxic and hepatotoxic activities which may be due to its free radical removal and antioxidant activity, resulting from the presence of semiflavonoids isolated from the extracts. This conclusion conflicts with previous results showing that many flavonoids have the potential to be liver protective agents. Moreover, **Aloh *et al*., (2015)** revealed that *delonix regia* is a rich source of potential antioxidants and these effects may be related to its biochemical components in leaves and flowers, the most important of which are lupeol phenol, β-sistosterol, carotenoids, flavonoids and other polyphenols.

Effect of *delonix regia* on liver enzymes (AST, ALT and ALP) for renal failure rats

Serum total protein (T.P), Liver enzymes including aspartate amino trans aminase (AST) and alanine amino trans ferase (ALT) in rats inflicted with renal failure then treated with *delonix regia* leaves, pods and mixture of them are listed, as mean values± standard deviation, in table (5).

It could be cleared for rats injected with gentamicin without treatment (control +ve) group that mean values of serum levels of total protein (T.P) was 13.04±0.59 mg/dL, while in normal rats (control -ve) group was 26.18±1.94 mg/dL, denoting significant decrease in control positive comparing to control negative group. All treated groups showed significant increase in total protein compared to control positive group, moreover, rats orally treated with 5% of *delonix regia* leaves showed the highest significant increase comparing with all other treated groups. Concerning, aspartate amino trans aminase (AST) and alanine amino trans ferase (ALT), the serum values were 69.90±3.29 and 59.27±1.69 U/L, in control positive groups compared with 35.27±1.99 and 29.02±0.49 U/L, in control (-ve) normal rats, denoting significant decrease for AST and ALT in control +ve compared with control -ve groups. Rats injected with gentamicin then orally fed with 5% of *delonix regia*

leaves showed significant decrease compared to other treated and control positive groups.

Table (5): Effect of *delonix regia* on T.P, AST and ALT in rats inflicted with renal failure at the end of study

Parameters Animal group	T.P (mg/dL)	AST (U/L)	ALT (U/L)
Control (-)	26.18±1.94 **a**	35.27±1.99 **e**	29.02±0.49 **e**
Control (+)	13.04±0.59 **e**	69.90±3.29 **a**	59.27±1.69 **a**
Pods 5%	15.19±0.09 **d**	55.40±2.04 **b**	48.35±0.38 **b**
Leaves 5%	21.22±1.33 **b**	41.08±3.28 **d**	33.80±0.27 **d**
Mix 5%	19.37±0.29 **c**	49.15±2.77 **c**	39.43±0.45 **c**

Values are means ± SD. Means with different superscript letters in the same column were significantly different at p≤0.05.

These findings agreed with **Tragl and Reaven (1972)** and **Jefferson, *et al*., (1983)** who revealed total protein depletion in mice with diabetic nephropathy may be the result of inhibitory oxidative phosphorylation processes that lead to reduced protein synthesis, increased catabolism and reduced protein uptake. Also, **Sharma and Arora (2015)** who revealed that *delonix regia* possess copious phytochemicals, saponins, hydrocarbons, alkaloids, carotene, steroids, carotenoids, galactomannon, phytotoxins, flavonoids, tannins, , lupeol, terpenoids, glycosides and carbohydrates, in leaves, flowers, bark and roots. Moreover, **Aloh *et al*., (2015)** revealed that *delonix* Regia has been reported to have broad spectrum antibacterial and anti-fungal activities in flowers, anti-inflammatory and hydrolytic activities in flowers and bark, and has also been reported to have hepatoprotective, antimicrobial, and antioxidant activity. Moreover, **Ahmed *et al*., (2011**) stated that *Delonix regia* possesses a protective liver activity against CCL 4-induced hepatotoxicity in rats.

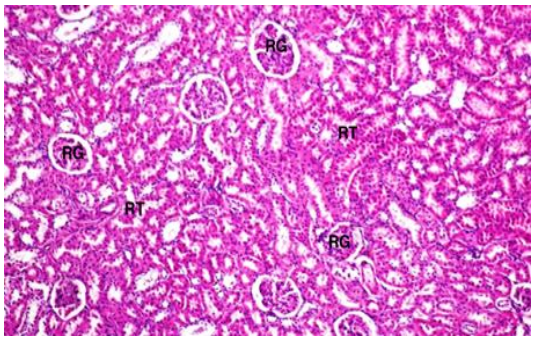
Furthermore, **Kwon *et al*., (2007**) reported that it is important to note that although flavonoids are effective in inhibiting tumor and/or cancer development and promotion, they are also non-toxic to normal cells, distinguishes their differential effects in abnormal cancer cells versus normal cells while at the same time manipulating levels of metabolic enzymes and stimulating detoxification enzymes, making them normal cells non-toxic.

Histological examination

Microscopic examination of different kidney sections of control rats showed normal histological structure of the renal glomeruli and renal tubules **(Photos 1 and 2).** While examination of kidney tissue of control positive rats showed marked tissue alterations. The interstitial blood vessels showed severe congestion and others showed perivascular and focal hyalinization of the wall with few inflammatory cells' infiltration in the interstitial tissue and various degenerative and necrotic changes of the renal tubular epithelium **(Photo 3).** Marked granular and vacuolar degeneration, nuclear pyknosis, necrosis and desquamation of the renal tubular epithelial linings were observed with congestion of the glomerular capillaries and eosinophilic cast in the Bowman's' space. **(Photo 4).** Some atrophied glomeruli were noticed. Congestion of the interstitial blood vessels accompanied many intertubular pockets of hemorrhages was observed with degeneration, necrosis and desquamation of the renal tubular epithelium **(Photo 5).**

Some glomeruli showed hypercellularity of the glomerular tufts, lysis of others' tufts **(Photo 6).** Regarding the treated groups, treatment with *delonix regia* leaves and mix., 5% groups were more effective than *delonix regia* pods 5% group. The kidney of control positive rats that treated with *delonix regia* pods 5% showed moderate degree of degenerative and necrotic changes of the tubular linings, some desquamated, few nuclear pyknosis with some pockets of hemorrhages **(Photo 7),** with restoration of the glomerular changes **(Photo 8).**

Kidney of control positive rats that treated with *delonix regia* leaves 5% showed good restoration of the renal tissue with tubular epithelial cells with few necrotic and desquamated ones **(Photos 9 and 10).** Concerning, kidneys of control positive rats that treated with *delonix regia* mixture of pods and leaves groups 5% showed mild tubular linings' necrobiotic changes and early eosinophilic materials in the lumen of few tubules **(Photo 11).** Mild congestion of the glomerular capillaries and near to normal appearance of most of the renal tubular epithelium with scattered few degenerated ones were all observed **(Photo 12).**



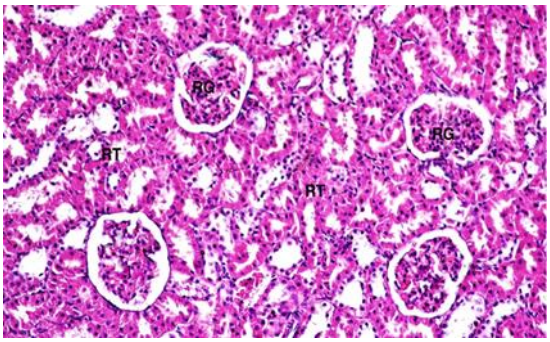


Photo (1): Kidney of control rat showing normal histological structure of the renal glomeruli (RG) and renal tubules (RT). (H&E, X200).

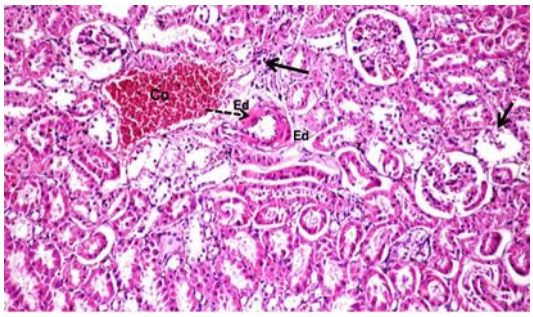


Photo (2): Kidney of control rat showing normal histological structure of the renal glomeruli (RG) and renal tubules (RT). (H&E, X400).

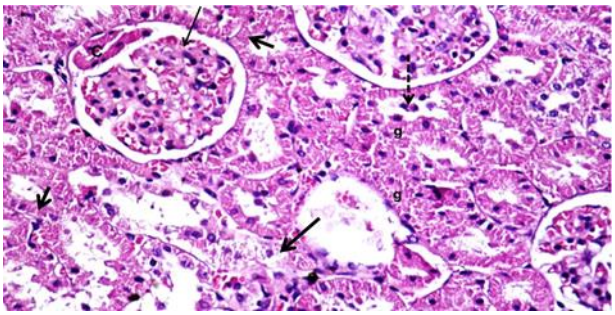
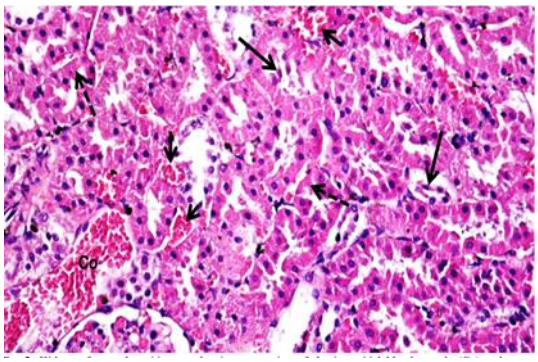


Photo (3): Kidney of control positive rat showing severe congestion of the interstitial blood vessels (Co), other blood vessels showing perivascular edema (Ed) and focal hyalinization of the wall (dashed arrow), few inflammatory cells infiltration (arrow) and various degenerative and necrotic changes of the renal tubular epithelium with some atrophied glomeruli (AG). (H&E, X200).

Photo (4): Kidney of control positive rat showing marked granular (g) and vacuolar (arrow) degeneration, nuclear pyknosis, necrosis (short arrow) and desquamation (dashed arrow) of the renal tubular epithelial linings, notice congestion of the glomerular capillaries (thin arrow) and esinophilic cast (C) in the Bowman's' space. (H&E, X400).



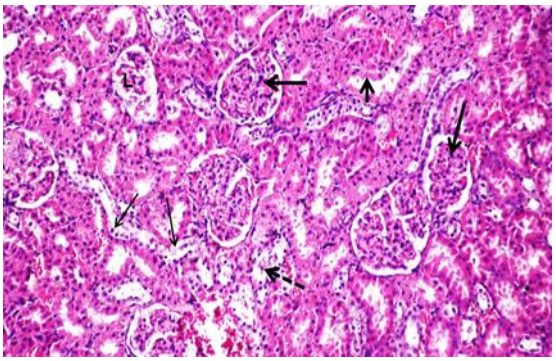


Photo (5): Kidney of control positive rat showing congestion of the interstitial blood vessels (Co) and many intertubular pockets of hemorrhages (short arrow) with degeneration, necrosis (dashed arrow) and desquamation (arrow) of the renal tubular epithelium. (H&E, X400).

Photo (6): Kidney of control positive rat showing hypercellularity of the glomerular tufts (arrow), lysis of others' tufts (L), tubular epithelial vacuolar degeneration (thin arrow), desquamation (dashed arrow) and necrosis (short arrow). (H&E, X200).

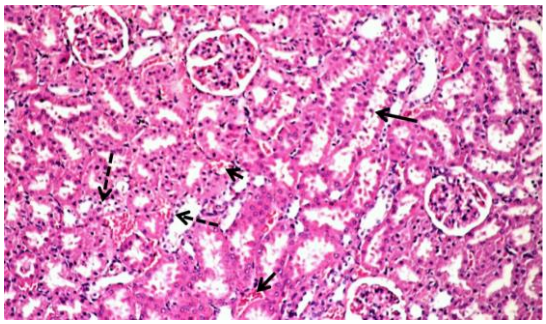


Photo (7): Kidney of control positive rat that treated with 5% *delonix regia* pods showing moderate degree of degenerative and necrotic changes of the tubular linings, some desquamated (arrow), few nuclear pyknosis (dashed arrow), notice some pockets of hemorrhages (short arrow). (H&E, X200).

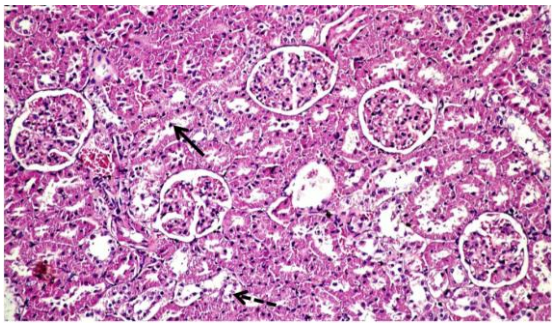


Photo (8): Kidney of control positive rat that treated with 5% *delonix regia* pods showing moderate degree of degenerative and necrosis changes of the tubular linings, some desquamated (arrow), few nuclear pyknosis (dashed arrow) with restoration of the glomerular changes. (H&E, X200).

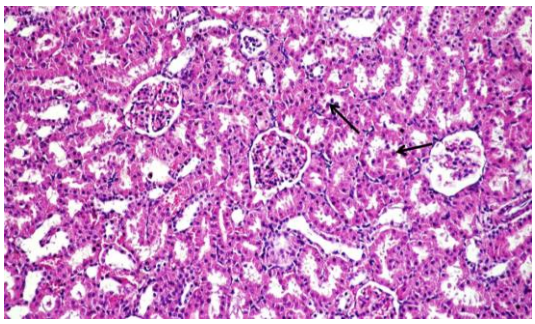


Photo (9): Kidney of control positive rat that treated with 5% *delonix regia* leaves showing good restoration of the renal tissue with tubular epithelial cells with few necrotic and desquamated (arrow) ones. (H&E, X200).

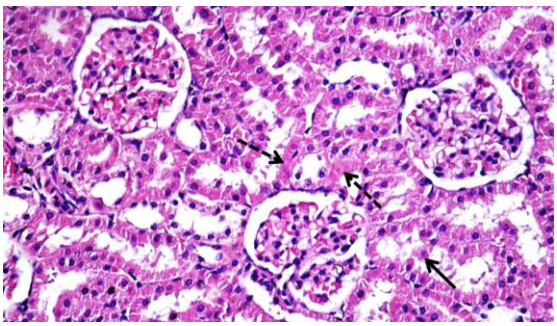


Photo (10): Kidney of control positive rat that treated with 5% *delonix regia* leaves showing good protection of the renal tissue with mild degeneration, necrosis (dashed arrow) and few desquamated (arrow) cells. (H&E, X400).

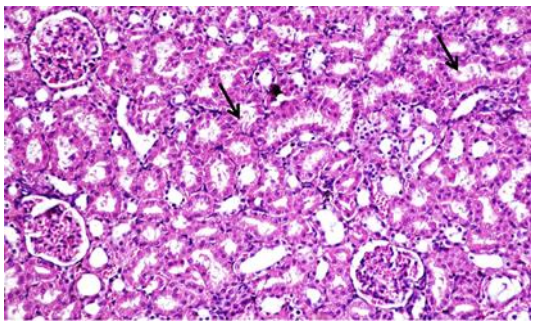


Photo (11): Kidney of control positive rat that treated with 5% *delonix regia* pods and leaves mixture showing mild tubular linings' necrobiotic changes and early eosinophilic materials in the lumen of few tubules (arrow). (H&E, X200).

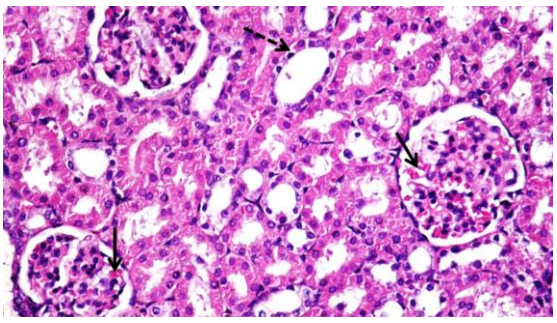


Photo (12): Kidney of control positive rat that treated with 5% *delonix regia* pods and leaves mixture showing mild congestion of the glomerular capillaries (arrow) and near to normal appearance of most of the renal tubular epithelium with scattered few degenerated ones (dashed arrow). (H&E, X400).

In conclusion: This study revealed that *delonix regia* had positive nutraceutical and therapeutic effects on kidneys vitality in rats inflicted with renal failure without side effects related to other body functions. Moreover, enhancing liver function, lipids profile and histological investigation for rats inflicted with renal faliure.

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التأثيرات الغذائية والعلاجية المحتملة لأوراق وقرون البونسيانا على حيوية الكلى في الفئران المصابة بالفشل الكلوي

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ملخص البحث

ازدادت حالات الإصابة بالفشل الكلوي وانتشاره في الآونة الأخيرة وفي معالجة العبء العالمي الذي يترتب عليه عواقب مالية عالية ليس فقط في البلدان النامية ولكن أيضًا في البلدان المتقدمة. استهدف البحث دراسة التأثيرات الغذائية والعلاجية لأوراق وقرون البونسيانا على حيوية الكلى في الفئران المصابة بالفشل الكلوي. تم تقسيم خمسة وثلاثين فأر ذكور من نوعالألبينو تراوحت أوزانهم ١٥٠ ± ١٠ جم إلى خمس مجموعات متساوية (ن= ٧ فئران) ؛ اعتبرت مجموعة واحدة منهم كمجموعة الضابطة سالبة (**C -ve**) ، بينما حقنت المجموعات الأربع الأخرى عن طريق الحقن البريتوني بواسطة الجنتاميسين لاحداث فشل كلوي، ثم تركت مجموعة واحدة منهم كمجموعة ضابطة موجبة (**C + ve**)، بينما تغذت المجموعات الثلاث الأخرى على ٥٪ قرون وأوراق وخليط منهما لعشبة البونسيانا لمدة ٤٥ يوم متتالية. في نهاية التجربة تم حساب زيادة وزن الجسم والمأخوذ الغذائي ومعدل الاستفادة من الغذاء، علاوة على ذلك تم قياس وظائف الكلى (الكرياتينين واليوريا وحمض البوليك) والدهون الثلاثية والكوليسترول الكلي والبروتين الدهني عالي الكثافة، والبروتين الدهني المنخفض الكثافة والبروتين الدهني المنخفض الكثافة جدا والبروتين الكلي وأنزيمات الكبد وكذلك الفحص الهستولوجي للأنسجة. أظهرت النتائج التي تم الحصول عليها أن جميع الفئران التي تم تغذيتها على من ٥٪ قرون وأوراق وخليط منهما لعشبة البونسيانا انخفاضًا معنويًا في وزن الجسم ومعدل الاستفادة من الغذاء ووظائف الكلى والدهون الثلاثية والكوليسترول الكلي والبروتين الدهني المنخفض والمنخفض جدا في الكثافة وإنزيمات الكبد ولكن حدثت زيادة في البروتين الكلي والبروتين الدهني عالي الكثافة، علاوة على ذلك حدث تحسن في الفحص الهستولوجى لانسجة الكلى. توصى الدراسة بأن عشبة البونسيانا تمتلك تأثيرات غذائية وعلاجية إيجابية على حيوية الكلى في الفئران المصابة بالفشل الكلوي دون حدوث تأثيرات جانبية على وظائف الجسم الاخرى.

الكلمات المفتاحية: *فشل الكلى، البونسيانا، الفئران، الفحص الهستولوجي.*