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Effect of supplements diet with potassium and phosphorus as minerals and the gum Arabic on rats kidney failure induced by adenine

Safaa Moustapha Abd El Fatah Faid
Department of Home Economics, Faculty of Specific Education, Ain Shams University, Cairo, Egypt
Department of Food Science and Nutrition, College of Science, Taif University, Saudi Arabia

Abstract
Gum Arabic is commonly utilized in Middle East countries to improve the kidney function of rats with kidney failure. This study aimed was carried out to the nutritional composition and amino acid content was determined in gum Arabic. As well As, it was the effect of drinking gum Arabic in water form at levels 3, 6, 9 and 12% w/v on adenine-induced kidney failure. Kidney functions and lipids profile changes during the experimental period (six weeks) were determined.
The results found that the gum Arabic is a good source from total carbohydrates, minerals content (copper, manganese, zinc and iron) and total phenolic and total flavonoids compounds. The main amino acids detected to be hydroxyproline, serine, proline, leucine, aspartic acid; glycine, threonine, and histidine.
At the end of experiential period, from the results of lipid profile, it could be noticed that the control positive was higher in total lipids, triglycerides, total cholesterol, LDL and VLDL and control negative is lower. Moreover, when the gum Arabic increased the lipid profile decreasing in the other treated kidney failure to nearly and equal control negative. The results from kidney function and bilirubin noticed that the gum Arabic in the form of drinking water with 15%, w/v improve the kidney functions in plasma may be due to adenine-induced kidney failure in rats and bilirubin was also reduced. The gum Arabic in the form of drinking water with 15% w/v exhibited the best results for both Na and K serum levels.
It could be concluded that the gum Arabic had contained rich amounts from nutritional composition and also, main amino acids compounds. Whilst, the gum Arabic in drinking water until 15% w/v concentration to rats groups kidney failure give the best results for lipid profile and kidney function and also the histological experiential confirmed the previously results.

Keywords: minerals- gum Arabic - kidney failure- adenine

Introduction

Gum Arabic had contained higher molecular weight polysaccharides and some minerals, which on hydrolysis yield from some saccharine like arabinose, galactose, rhamnose, and glucuronic acid The fermentable natural fiber of gum Arabic act as probiotics improves the absorption of minerals, especially calcium and helps to maintain a healthy balance of bacteria in the gastrointestinal (GI) tract. Extraction, transformation, or reprocessing of nitrogenous wastes (ammonia, urea, and uric acid) by the GI tract is a potentially low‑cost means of switching for missing renal function. Binding of nitrogen compounds to be inert orally by the administration of gum Arabic is the safe solution either in normal renal function or renal failures (Dashtdar and Kardi, 2018) [12].

The kidneys play a role in potassium homeostasis and their significance to the conservation of potassium balance is reflected by great rates of potassium troubles in patients with decreased kidney function (Stanton, 1989) [45]. Indeed, individuals with chronic kidney disease (CKD) and those with end-stage renal disease (ESRD) can experience both hyperkalemia and hypokalemia happen by virtue of their low kidney function or as a result of drugs causing a diuretic administration (Palmer, 2004) [39].

Between dialysis patients, hyperkalemia has been connected with greater mortality may be caused by its arrhythmogenic influences (Genovesi *et al.*, 2009) [24]. Hypokalemia has also been related to elevating mortality in dialysis patients, not only for the reason that the electrophysiological influences of potassium but also for the reason that hypokalemia usually reflects a poor nutritional status (Lowrie and Lew, 1990) [32]. Also, Hayes *et al.* (2012) [26] observed that the connection through serum potassium and mortality follows a U-shaped curve, in which both low and high serum potassium is connected with an increase in mortality.

To prevent hyperkalemia in patients with advanced CKD and end-stage kidney disease (ESKD) who are undergoing hemodialysis, opinion-based guidelines recommend a low-potassium diet. This practice is widespread, and studies evaluating adherence to dietary recommendations in patients undergoing hemodialysis consistently report low potassium intake with corresponding low intake of fruits, vegetables, and other plant-derived compounds (e.g., fiber, vitamin C, and carotenoids) (Therrien *et al.*, 2014 and Luis *et al.*, 2016) [46, 33] However, observational studies in persons with CKD or ESKD report weak associations between dietary potassium intake and potassium concentration, (Gritter *et al.*, 2018) [25] challenging the belief that the amount of potassium consumed strongly influences potassium concentration

Preserving normal serum phosphate levels is significant for maintaining kidney bone disease and calcification of the soft tissue in patients with kidney failure. Elevate in blood phosphate is not often seen until the last stages of kidney failure. Further action to a nephrologist is requisite to optimize kidney bone disease administration during the prescription of phosphorus binding medications and vitamin D derivatives. Give advice concerning a low phosphorus diet that may usually be delayed until a person is seen by a multidisciplinary kidney group. Thus, further researches are required to examine the influence of low phosphorus and potassium diet, on nutritional issues of rats suffering from kidney failure (National Kidney Foundation, 2003) [36].

The influence of serum phosphorus on kidney disease itself stays uncertain. In nondialysis chronic renal disease and nonchronic renal disease populations, little elevate in phosphorus levels, even during normal ranges, have been observed to be connected with higher mortality and chronic heart disease result (Dhingra *et al.*, 2007) [14]. In topics with progressive chronic renal disease, greater serum phosphorus levels have been observed to estimate that elevated happening of end-stage kidney disease, indicating that phosphorus increasing may adversely influence kidney function (Zoccali *et al.*, 2011) [49].

The target of this study was achieved to estimate the influence of gum Arabic drinking in the water form at 3, 6, 9 and 12% which supplemented with some minerals and adenine in the basal diet to induce kidney failure in rats. Kidney functions, lipid profile and serum minerals were determined.

Materials and Methods

Materials

Gum Arabic (*Acacia senegal* L.) GA was obtained from Sigma (St. Louis, MO, USA) as in Figure (A and B).

Adenine, used for induction of chronic kidney disease (CKD) among rats was purchased from Sigma Chemical Co. (St. Louis, MO, USA).

Kits for determination of the parameters were purchased from Sigma-Aldrich Corp., MO, USA**.**

Fig 1: Natural gum Arabic is in chunks crystals. Gum Arabic has a bland taste and is odorless

Fig 2: Natural gum Arabic powder

Methods

The Nutritional analysis of gum Arabic

Moisture, protein, fat, crude fibers and ash content were determined in the gum Arabic according to the methods of AOAC (2005) [6] and also, total carbohydrates were determined by differences. Minerals content as copper, manganese, zinc and iron were determined according to the methods of AOAC (2005) [6].

Estimation of total phenolic acids and total flavonoids compounds

The total phenolic content in the extract was measured using the method of Qawasmeh *et al.* (2012) [42] with Folin-Ciocalteu reagent. The UV reading was measured at 760 nm. Gallic acid was used as standard (1 mg/ml) and the results were expressed as gallic acid equivalents (GAE mg/100g of dry weight).

The total flavonoids content was determined by the method of Eghdami and Sadeghi (2010) [18]. The absorbance was measured against a blank solution at 510 nm and the total 143 flavonoid content was expressed in terms of milligrams of quercetin equivalent per gram dry weight (mg QE /100g DW).

Determination of amino acids profile of gum Arabic (*Acacia senegal*)

Amino acids content in gum Arabic was determined using amino acids analyzer Biochrom 30 using the instruction manual according to AOAC (2005) [6].

Biological experimental:

Male albino rats (n=42 rats), 160-180g per each, were purchased from Pharmacy Collage at King Saud University and delivered to the King Fahd Medical Research Center in Jeddah. The basal diet which consisted of corn starch 65%, casein 15% which contained on 20% protein, modified salt mixture 4% (2.12g salt mixtures and 1.18g phosphorus plus 0.7g potassium), vitamin mixture 1% and cellulose 5% was prepared according to Pell *et al.* (1992) [41]. Rats were housed individually in wire cages in a room maintained at 25 ± 2ºC and kept under normal healthy conditions. All rats were fed on basal diet for one-week before starting the experiment for acclimatization. After one-week period, the rats were divided to six groups; the first group (6 rats) were fed on basal diet and described as control negative. The second group (6 rats) was fed on basal diet plus 0.75% adenine to induce kidney failure and described as control positive. The groups three, four, five and six were given 0.75% adenine in basal diet plus gum Arabic in drinking water at a concentration of 3, 6, 9, 12 and 15% w/v, respectively, for six weeks.

At the end of experiment period, six weeks, blood samples were collected after 12 hours fasting using the abdominal aorta and rats were scarified under ether anesthetized. Blood samples were withdrawn from the antecubital vein into glass centrifuge tubes, containing oxalate solution (1.34 %) as anticoagulant. After centrifugation at 3000 rpm for 10 min., plasma was with drown and used for the analysis. The levels of serum glucose, total lipids, total cholesterol and triglycerides were determined according to Tietz (1986) [10], knight *et al.* (1972) [29], Allain *et al.* (1974) [4] and Fossati and Prencipe (1982) [22], respectively. High, low and very low-density lipoprotein- cholesterol in serum was determined according to Burstein (1970) [11], Fruchart

(1982) [23] and Lee and Nieman (1996) [31]. Kidney functions as serum creatinine, urea and uric acid concentrations were determined using the methods of Bowers and Wong (1980) [8], Burtis and Ashwood (1999) [10] and Jelikić-Stankov *et al.* (2003) [28] respectively.

Sodium (Na) and potassium (K) content in serum samples were determined by the adaptation the method mentioned by Doku and Gadzekpo (1996) [16]. Moreover, total bilirubin is assessed using caffeine benzoate to split bilirubin from the unconjugated bilirubin protein complex according to Vinchi *et al*. (2008) [48].

Histopathological examination of kidney rats

Kidney tissues were immediately preserved in 10% neutral buffered formalin, dehydrated through graded alcohol series, embedded in paraffin, cut into 5 mm sections and stained with hematoxylin and eosin (H&E). The slides were examined by light microscopy under 400 × magnifications for microscopic alterations of pathological significance.

Statistical analysis

The obtained data were exposed to analysis of variance. Duncan's multiple range tests at ($P \leq 0.05$) level was used to compare between means. The analysis was carried out using the PRO ANOVA procedure of Statistical Analysis System (SAS, 2008) [44].

Results and Discussion

The nutritional constituents of gum Arabic (*Acacia senegal*)

Table (1) showed that the chemical composition, minerals content, total phenolic and flavonoids compounds for gum Arabic powder. The results observed that the gum Arabic is a good source from total carbohydrates (89.19%) and minerals content as copper, manganese, zinc and iron were 61.0, 97.0, 87.0 and 1573 ppm. These results are agreement with Dauqan and Abdullah (2013) [1]showed that the chemical constituents as moisture content, ash content, Internal energy, volatile matter, optical rotation (degrees), total protein and nitrogen content were determined in gum Arabic and the results ranged from 13.0 15.0%, 2.0 to 4.0%, 30.0 to 39.0%, 51.0 to 56.0%, -26 to -34 degree, 0.71to 4.18 and 0.26 to 0.39%, respectively. Islam *et al.* (1997) [27] observed that the chemical analysis of gum Arabic had contained the highest amount of total carbohydrates (97%), and a low percentage of proteins (<3%). The chemical composition of GA can vary with its source, climatic conditions, and soil environment.

In gum Arabic the total carbohydrate hydrophilic and hydrophobic proteins, the moisture content facilitates their solubility (Elmqvist, 2003) [19]. The total ash content is utilized to evaluate the insoluble matter in acid, calcium, potassium, and magnesium. The ingredients of cations in the ash residue from gum Arabic are utilized to estimate the levels of heavy metals to evaluate gum Arabic quality (FAO, 1996) [21].

Malik *et al.*, (2011) [34] reported that the minerals as zinc; iron and manganese are significant co-factors were reported in the structure of confirmed enzymes and are necessary for many biochemical cycles. Ogbe *et al.*, (2011) [38] found that, amount of Fe, Zn, Mn, and Cu was 98.42, 47.77, 81.65 and 5.94 ppm in Arabic gum respectively. Also, Ademoh and Abdullahi, (2009) [15] reported that Arabic gum contain 1.41 mg/100g Fe, 0.03 mg/ 100g Zn, 0.33 mg/ 100g Mn and o.16 mg/ 100g Cu.

Concerning that the gum Arabic had contained rich amounts from total phenolic and total flavonoids compounds in methanol extract were 28.0GAE g/100g and 16.0 QE g/100g, respectively. These results confirmed by Amoussa *et al.* (2015) [5] who found that the total phenolic, flavonoids and flavonol compounds were determined and the results are reported that the highest natural antioxidant in ethyl acetate extract was 74.18 mg GAE/100mg, 26.65 mg QE/100mg, and 23.14 mg QE/100mg. Hence, *Acacia ataxacantha* had a source of powerful natural antioxidants that could be utilized in pharmaceutical and food ingredients.

Table 1: The nutritional analysis of gum Arabic

Chemical composition	Gum Arabic (*Acacia Senegal*)
Moisture %	13.0±1.64
Protein %	3.72±0.92
Lipids %	1.15±0.01
Ash content %	3.67±0.24
Crude fiber %	2.27±0.94
Total carbohydrates %	89.19±5.34
Copper ppm	61.0±4.38
Iron ppm	1573.0±216.0
Manganese ppm	97.0±7.39
Znic ppm	87.0±6.51
Total phenolic acids mg/100 GAE	28.0± 3.27
Total flavonoids compounds mg/100g QE	16.0 ±2.14

Values are mean and SD (n = 3)

Amino acid composition for gum Arabic

The amino acid composition of the gum Arabic was analyzed and the results of which are presented in Table (2). The main amino acids detected to be hydroxyproline, serine, proline, leucine, aspartic acid; glycine, threonine, and histidine were shown 15.0, 12.0, 8.5, 8.0, 7.5, 7.3, 7.0 and 6.8 g/100g protein, respectively. Phenylalanine, valine, glutamic, alanine and lysine were contained 5.0, 4.9, 3.9 and 3.3 g/100g protein, respectively. Aso, tyrosine, arginine, cystine, and methionine were ranged from 0.3 to 2.8 g/100g protein. This suggests that gum Arabic may contribute a significant amount to the supply of essential amino acids in the diet. Dauqan and Abdullah, (2013) [1] decided that gum Arabic had the amount value of serine, threonine, histidine, which values were 28.70, 15.90, and 10.70 nmol/mg, respectively**.**

Table 2: Amino acid composition for Gum Arabic (*Acacia Senegal*) on dry basis

Amino acids (g /100g protein)	Gum Arabic (*Acacia Senegal*)
Allanine	3.9±0.61
Arginine	1.5±0.15
Aspartic	7.5±0.91
Glutamic	4.2±0.26
Glycine	7.3±1.05

Histidine	6.8±1.12
Hydroxyproline	15.0±3.28
Isoleucine	1.0±0.001
Leucine	8.5±1.37
Lysine	3.3±0.53
Phenylalanine	5.0±0.39
Proline	8.0±1.24
Serine	12.0±2.07
Tyrosine	2.8±0.14
Threonine	7.0±1.07
Valine	4.9±0.73
Cyctine	1.0±0.001
Methionine	0.3±0.000

Values are mean and SD (n = 3)

Effect of gum Arabic and some minerals content on lipids profile in rat's kidney failure.

The effects of some minerals content in basal diet plus 0.75% adenine to induce kidney failure and gum Arabic in drinking water at a concentration of 3, 6, 9 and 12% w/v on lipids profile in rats during period experimental (six weeks) were determined and the results are recorded in Table (3**).** From the results it could be noticed that the control positive was higher in total lipids, triglycerides, total cholesterol, LDL and VLDL were 380, 145, 220, 122 and 29.0mg/dl, than control negative was 210, 75.0, 140, 36.0 and 15.0 mg/dl, respectively. Whilst, HDL was higher in control negative (100.0 mg/dl) than control positive was 80.0 mg/dl. Moreover, the rat groups (3, 4, 5 and 6) fed on some minerals content in basal diet plus 0.75% adenine to induce kidney failure and gum Arabic in drinking water at a concentration of 3, 6, 9 and 12% w/v, the lipid profile showed that when the gum Arabic increased the lipid profile decreasing to nearly and equal control negative. Meanwhile, LDL was decreased gradually when the gum Arabic concentrations increasing to nearly and equal control negative. These results are in harmony with Dvir *et al.* (2009) [17] found that the gum Arabic supplementation lowering plasma total cholesterol and cholesterol lipoprotein concentrations, whilst were elevated concentrations from cholesterol high lipoprotein. Many techniques have been suggested to detect the lowering of total cholesterol in serum influences of dietary fiber.

Lattimer and Haub (2010) [30] reported that one clarification is that dietary fiber elevates the viscosity of the intestinal contents, and therefore, interfering nutrient with absorption and micelle being formed, which, sequentially, decreases intestinal lipid absorption. The second mechanism mentions that the soluble fibers take action by stopping the enterohepatic circulation of bile acids, consequential to elevate bile acid excretion, and thereafter decreases plasma cholesterol concentrations (Parnell and Reimer, 2010) [40]. Furthermore, the viscosity of fermentable dietary fibers is shown to give help virtually to the lipid-reducing influences in rats (Brockman *et al.*, 2014).

Table 2: Effect of gum Arabic and some minerals content on lipids profile in rats renal failure.

Groups	Total lipids mg/dL	Triglycerides mg/dL	Total cholesterol mg/dL	LDL mg/dL	HDL mg/dL	VLDL mg/dL
Control -ve	210 ± 2.24 ^{e}	75 ± 1.25 ^{e}	140 ± 2.34 ^{e}	36±0.91^{g}	100±2.15^{a}	15±1.59 ^{e}
Control +ve	380± 6.11 ^{a}	145 ± 2.14 ^{a}	220 ± 4.59 ^{a}	122±5.13^{a}	80±1.95^{d}	29.0±3.21^{a}
Group 3	355 ± 5.38 ^{a}	135 ± 2.36 ^{a}	200 ± 4.16 ^{a}	102 ± 3.26 ^{b}	82 ± 2.01^{d}	27.0 ± 2.38^{a}
Group 4	305 ± 7.12^{b}	120 ± 1.79 ^{b}	180 ± 3.14^{b}	80 ± 3.24 ^{c}	87.3 ± 1.73^{c}	24.0 ± 1.17^{b}
Group 5	275 ± 3.45^{c}	107 ±1.65 ^{c}	165 ± 2.58 ^{c}	62 ± 1.75 ^{d}	93± 1.24^{b}	21.4± 1.25^{c}
Group 6	241 ± 3.75^{d}	95 ± 2.13^{d}	155 ± 2.67 ^{d}	50 ± 1.49 ^{e}	97± 1.26 ^{b}	19.0 ± 1.13^{d}
Group 7	217 ± 2.39^{e}	80 ± 1.01^{e}	145 ± 2.29 ^{e}	41 ± 1.18^{f}	100± 1.91^{a}	16.0± 0.95^{e}

Values are mean and SD (n = 3); where: Mean values in the same with the letter are significantly different at 0.05 levels.

Effect of gum Arabic and some minerals content on kidney function and total bilirubin in rats kidney failure.

Kidney function and total bilirubin were determined in rats' kidney failure and the results are illustrated in Table (4). The gum Arabic in the form of drinking water with 15%, w/v found that improve the concentrations of kidney functions in rats suffering kidney failure induced adenine. These results may be due to reducing the clearance of creatinine and induced important elevates in the inflammatory mediator's concentrations. Moreover, the therapy with GA considerably improves all preventing effects induced by adenine. Ali *et al.* (2003) found that the technology fundamental to the useful influence of gum Arabic in rats suffering adenine-induced kidney failure may support with mitigation of inflammation due to adenine. Furthermore, the preventative influence of gum Arabic on kidney function was also certain to considerably lowering kidney functions concentrations in diabetic kidney failure patients (Nasir *et al.*, 2016) [35].

The results from the same table showed that the rat's groups were fed of some minerals content in basal diet plus 0.75% adenine to induce kidney failure and gum Arabic in drinking water at a concentration of 3, 6, 9 and 12% w/v were decreased gradually in bilirubin when the concentration of gum Arabic increasing, this means the gum Arabic to prevent the red blood cells from dying in rats' kidney failure groups. Bilirubin is the degradation of products from hemoglobin which formed when red blood cells die. High levels of bilirubin were finding when too much amount from hemoglobin is broken. The accumulation of bilirubin in the body may be due to jaundice (Nedredal *et al.*, 2009) [37].

Dashtdar and Kardi (2019) [12] observed the treating with gum Arabic efficient with uric acid and bilirubin lowering and anti-inflammatory effects, considering the gum Arabic as a potential therapeutic supplement, beneficial in chronic renal failure, cardiovascular disease, pain management, and dental health and it has no side effect when consumed for a long time but also protects multi-organs damage from drug adverse reactions and consequences of baseline disease.

Table 3: Effect of gum Arabic and some minerals on kidney functions and total bilirubin in rats kidney failure.

Groups	Urea (mg/dl)	Creatinine (mg/dl)	Uric acid (mg/dl)	Bilirubin mg/dL
Control -ve	28.12 ±2.4^{e}	0.50 ±0.11 ^{e}	2.60 ±0.25 ^{e}	0.32 ± 0.01 ^{f}
Control +ve	44.26 ±3.0^{a}	1.27 ±0.24^{a}	5.77 ±0.61^{a}	0.72 ± 0.02 ^{a}
Group 3	41.59±1.83^{b}	0.73±0.32 ^{b}	3.69±0.31^{b}	0.58 ± 0.05 ^{b}
Group 4	37.49±1.72^{b}	0.70±0.21 ^{b}	3.06±0.24^{b}	0.52 ± 0.04 ^{c}
Group 5	35.96±1.94^{c}	0.65±0.22^{c}	2.95±0.45^{c}	0.47 ± 0.01 ^{d}
Group 6	32.58±1.68^{d}	0.62±0.16^{d}	2.79±0.75^{d}	0.40±0.03^{e}
Group 7	29.24±1.35^{e}	0.59±0.12^{e}	2.60±0.38 ^{e}	0.35 ± 0.02 ^{f}

Values are mean and SD (n = 3); where: Mean values in the same with the letter are significantly different at 0.05 levels.

Effect of gum Arabic and some minerals on serum sodium and potassium in rats kideny failure.

Table (5) indicated that the effects of different concentration of gum Arabic on serum sodium (Na) and potassium (K) levels in kidney failure rats. The reduction of potassium in blood in control negative group rats it has been assuming to be a danger agent for the advancement of chronic kidney disease (CKD), and also, it had been caused to induce kidney risk via amendment of kidney inflammation and weaken angiogenesis (Reungjui *et al*., 2008) [43]. Hypokalemia has been earlier time related to elevated mortality in patients with cardiovascular diseases (Ahmed *et al*., 2007) [2].

The gum Arabic in the form of drinking water with 15% w/v exhibited the best results for both Na and K serum levels 105 ± 2.99 and 16.1±1.00 mmol/L, followed by gum Arabic in the form of drinking water with 12% w/v was 125±2.66 and 14.7±0.70 mmol/L, and 9% w/v was 185 ± 4.11 and 12.7 ± 0.20 mmol/L, respectively. Sodium is a mineral that assists balance fluids in our bodies. It also assists our nerves and muscles work satisfactorily. Kidneys assist the body to preserve the complete amount of sodium. Weaken kidney concentrating techniques lead to extrarenal fluid losses by vomiting, diarrhea or pyrexia and may rapidly reason hypovolaemia and hypotension (Ash, 2015).

Fila *et al* (2011) [20] studied the nephrotic syndrome features enormous proteinuria and keeping of sodium which promotes ascites formation. In the puromycin aminonucleoside-induced rats of nephrotic syndrome, sodium retention produces from the collecting duct where it generates a driving force for potassium secretion. They found those nephrotic patients display plasma potassium levels in the normal to high range and recommend not only a reduce sodium diet but also a controlled potassium diet for patients with nephrotic syndrome.

Table 5: Effect of gum Arabic and some minerals on serum sodium and potassium in rats kidney failure.

Groups	Na mmol/l	K mmol/l
Control -ve	100 ± 2.12 ^{f}	16.9 ± 1.01^{a}
Control +ve	255±5.37^{a}	8.7±0.11 ^{f}
Group 3	220 ± 3.78 ^{b}	10.8 ± 0.40 ^{e}
Group 4	185 ± 4.11 ^{c}	12.7 ± 0.20 ^{d}
Group 5	157 ± 3.51 ^{d}	13.3 ± 0.30 ^{c}
Group 6	125 ± 2.66 ^{e}	14.7 ± 0.70 ^{b}
Group 7	105 ± 2.99 ^{f}	16.1± 1.00 ^{a}

Values are mean and SD (n = 3); where: Mean values in the same with the letter are significantly different at 0.05 levels.

Histopathological examination of kidney

Microscopically, kidneys of rats from group (1) revealed the normal histological structure of renal tissue (Figs. 1 and 2). On the other hand, kidneys of rats from positive group (2) showed that the vacuolar degeneration of epithelial lining renal tubules (Figs. 3 and 4), focal renal hemorrhage (Fig. 4), thickening of the parietal layer of Bowman's capsule and distension of Bowman's space (Fig. 5).

However, kidney of rats from group (3) fed on basal diet and 3.0g /kg/ day body weight from gum Arabic are revealed granular degeneration of epithelial lining renal tubules, slight congestion of glomerular tuft (Fig. 6) and slight congestion of renal blood vessel (Fig. 7).

Some examined sections from group (4) fed on basal diet and 6.0 g /kg/ day body weight from gum Arabic showed granular degeneration of epithelial lining some renal tubules and slight vacuolation of glomerular tuft (Fig. 8), whereas, other sections from this group revealed no histopathological alterations (Fig. 9).

A marked improved picture was noticed in sections from group (5) fed on basal diet and 9.0 g /kg/ day body weight from gum Arabic the kidney was revealed no histopathological alterations (Fig. 10) except slight congestion of renal blood vessel (Fig. 11) in some examined sections.

Meanwhile, some sections from group (6) fed on basal diet and 12.0g /kg/ day body weight from gum Arabic revealed no histopathological alterations (Fig. 12), whereas, other sections from this group showed vacuolar degeneration of epithelial lining renal tubules and slight congestion of glomerular tuft (Fig. 13). However, kidney of rats from group (7) fed on basal diet and 15.0 g /kg/ day body weight from gum Arabic showed no histopathological changes (Figs. 14 and 15).

Histological evaluation revealed that using gum Arabic in the basal diet at different concentrations the rats explained decrease vacuolar degeneration of tubules; periodic acid Schiff base (PAS) positivity staining intensity in glomeruli and basement membrane thickening. These results supply experimental proof that the gum Arabic has powerful antioxidant activity, carbohydrates, minerals content and high concentration from amino acid content which could be helpful in slowing the advancement of chronic kidney diseases.

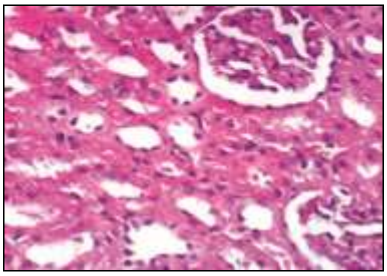

Fig 1: Kidney of rats from group (1) showing the normal histological structure of renal tissue (H & E X 400).

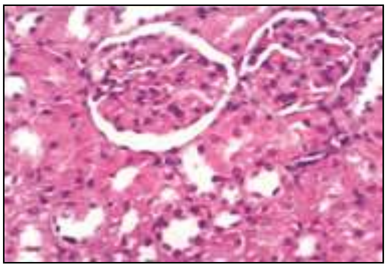

Fig 2: Kidney of rats from group (1) showing the normal histological structure of renal tissue (H & E X 400).

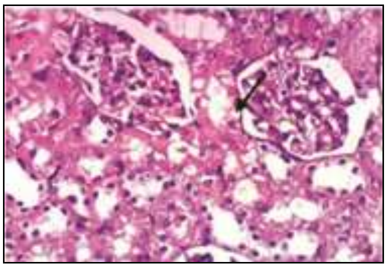

Fig 3: Kidney of rat from group (2) showing vacuolar degeneration of epithelia lining renal tubules (arrow) (H &X 400).

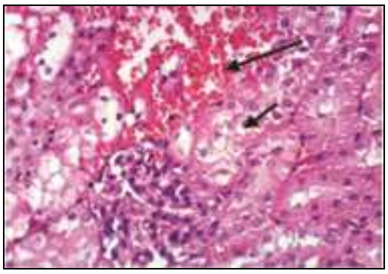

Fig 4: Kidney of rat from group (2) showing vacuolar degeneration of epithelia lining renal tubules (short arrow) and focal renal hemorrhage (long arrow) (H & E X 400).

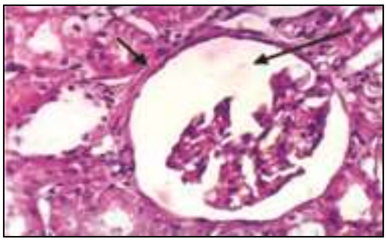

Fig 5: Kidney of rat from group (2) showing thickening of the parietal layer of Bowman's space (long arrow) (H & E X 400).

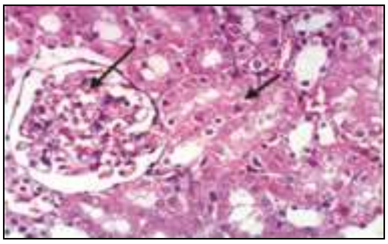

Fig 6: Kidney of rat from group (3) showing granular degeneration of epithelia lining renal tubules (short arrow) and slight congestion of glomerular tuft (long arrow) (H & E X 400).

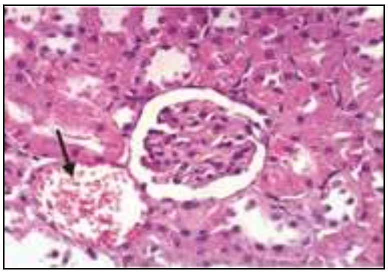

Fig 7: Kidney of rat from group (3) showing slight congestion of renal blood vessel (arrow) (H & E X 400).

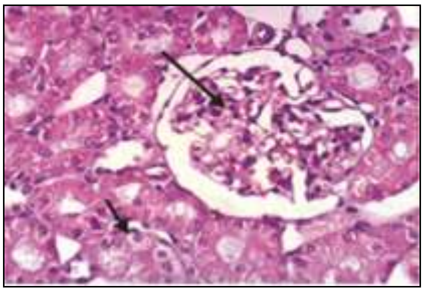

Fig 8: Kidney of rat from group (4) showing granular degeneration of epithelial lining some renal tubules (short arrow) and slight vacuolation of glomerular tuft (long arrow) (H & E X 400).

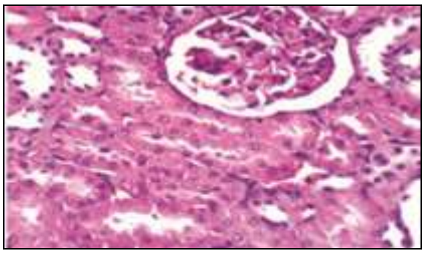

Fig 9: Kidney of rat from group (4) showing no histopathological alterations (H & E X 400).

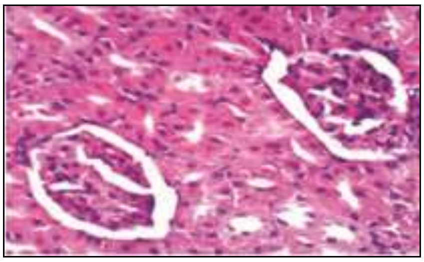

Fig 10: Kidney of rat from group (5) showing no histopathological alterations (H & E X 400).

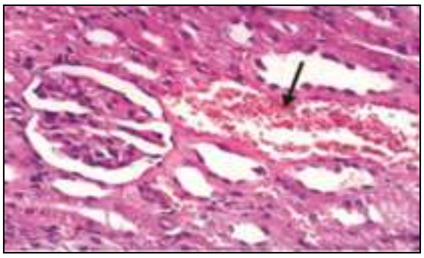

Fig 11: Kidney of rat from group (5) showing slight congestion of renal blood vessel (arrow) (H & E X 400).

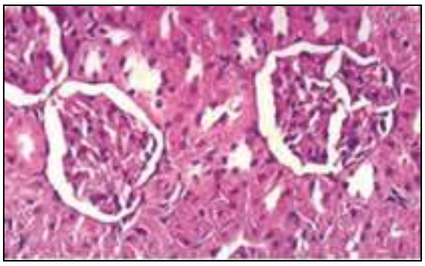

Fig 12: Kidney of rat from group (6) showing no histopathological alterations (H & E X 400).

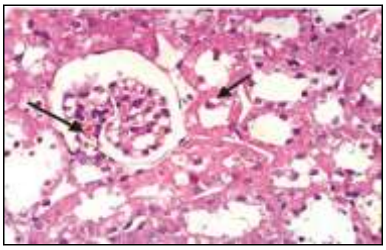

Fig 13: Kidney of rat from group (6) showing vacuolar degeneration of epithelia lining renal tubules (short arrow) and slight congestion of glomerular tuft (long arrow) (H & E X 400).

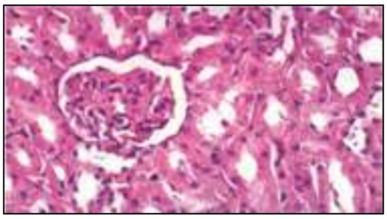

Fig 14: Kidney of rat from group (7) showing no histopathological alterations (H & E X 400).

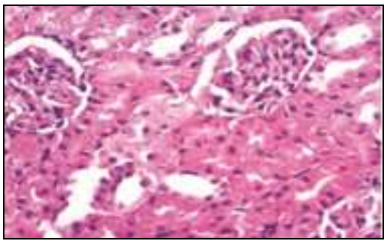

Fig 15: Kidney of rat from group (7) showing no histopathological alterations (H & E X 400).

Conclusion

In conclusion, this study observed that gum Arabic have the ability to ameliorate renal damage induced by adenine in rats. Its amelioration of adenine-induced renal failure is evident through lowering in levels of urea, uric acid, and creatinine, and restored total bilirubin levels as well as reductions in lipids profile. Histopathological examination of kidney confirmed the previously results.

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