

Effect of Gum Arabic Administration on Some Physiological and Biochemical Parameters in Chronic Renal Failure Patients

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ABSTRACT

The aim of this study was to assess the effect of long-term administration of Gum Arabic (*Acacia Senegal*) on some physiological and biochemical parameters of chronic renal failure (CRF) patients who were under regular hemodialysis. Fifty patients aged 23-56 years were recruited in the study, the patients given 30 g of GA daily for six months. Blood specimens were obtained before supplementation GA and then after six months. Urea, creatinine, uric acid, electrolytes, liver function tests, cholesterol, triglycerides, RBCs, WBCs, platelet count and PCV were measured. GA significantly decrease urea, creatinine, uric acid, liver enzymes, total bilirubin, potassium, phosphor, glucose, cholesterol and triglycerides and significantly increase total protein,

albumin, calcium, sodium and RBCs, platelets count and PCV $P \leq 0.05$. The results suggest that GA is a good dietary fiber used for CRF patients.

Keywords: Gum Arabic, Chronic Renal Failure, Urea, Alkaline phosphatase ALP, Albumin

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INTRODUCTION

Gum Arabic or Acacia gum is a heteropolysaccharide dietary fibrous able to be dissolved in water produced from the dry gummy secretions of Acacia Senegal stems and branches which are cultivated in the Sudan as a cash crop in agro forestry system [1,2]. The gum Arabic has a high molecular weight (approx. 350- 850 kDa) and composed majorly of macromolecules (carbohydrates and protein), minerals and amino acids, the major carbohydrates in gum Arabic are rhamnose, arabinose, galactose and glucuronic acid. It is rich in some amino acids such as hydroxyproline, serine, threonine, proline, leucine and histidine, gum Arabic is a valuable source of four antioxidant minerals copper, iron, manganese and zinc [3]. Oral administration of GA has been revealed to offer many health benefits in different organs and diseases, GA treatment decreased fat peroxidation, enhanced the antioxidant enzymes activities and their mRNA expression in the hepatic cells of diabetic rats [4]. GA has effective anti-oxidative effects in patients with sickle cell anemia by its ability to increase Total antioxidant capacity (TAC) [5]. GA can alleviate the lung toxicity induced by herbicidal agents (paraquat) in mice via countering the generation of free radicals which causes oxidative stress in the lung tissue [6]. GA provides protection effect against cyclophosphamide-induced cytotoxicity of urinary bladder in rats by counteracting ROS and alleviating oxidative stress [7]. GA exhibit renoprotective effects against cisplatin-induced nephrotoxicity in a rat model by its ability to reduce malondialdehyde (MDA) renal level [8]. GA treatment lower proteinuria, decreases the concentration of plasma phosphate and rises the glomerular filtration rate in diabetic rats [9]. GA exhibit renoprotective effect against adenine producing renal toxicity in rats based on its antioxidant effect [10].

Chronic Renal Failure (CRF) disease from all causes is one of the greatest and rapidly mounting demands to the health care system in developed and developing countries [11]. People with CRF have significantly higher rates of

morbidity, mortality, hospitalizations and healthcare utilization [12]. Many studies showed that GA has beneficial role in the treatment of acute and chronic renal failure [13,14,15,16]. In recent times there has been an increasing interest in utilizing natural phytochemical materials as treatment replacements in several conditions comprising renal disease, because of their lower toxicity, lower price and broad availability, GA is one of these natural compounds [17]. The aim of this study was to evaluate the long term effect of GA administration in CRF patients by measuring kidney function test including urea, creatinine and uric acid in addition to determine calcium, sodium, potassium and phosphorus concentration, and measuring liver function test including alkaline phosphatase (ALP), serum aspartate aminotransferase (AST), serum alanine aminotransferase (ALT), total protein, albumin, globulin and serum total bilirubin in addition to measure serum glucose, Total cholesterol and triglycerides. Some haematological parameters including WBCs, RBCs, platelets counts and PCV also measure in this study after six month from oral intake of GA.

METHOD AND MATERIALS

Study population

Fifty patients with CRF and under steady haemodialysis treatment in Al-Hayat Dialysis Center in Al-Karama Teaching Hospital during February 2018 to February 2019, were recruited in this study.

Patients under antibiotics therapy, those who were under further than two haemodialysis meeting for each week, patients with blood transfusion and patients not willing to participate in study were excluded from this study.

Gum Arabic oral intake

A daily dose of 30 g of natural extract powder of GA were given to patients, we asked them to dissolve it in 200 mL of water and consuming it in early morning for six month, GA in powder shape was produced from mature Acacia Senegal

trees and provided from Dar Savanna Ltd., Khartoum, Sudan.

Sample collection

Blood samples were collected before administering GA and after six month of treatment, two ml of blood were putted in EDTA tube container and eight ml in normal container, serum was collected after centrifugation at 3000 rpm for 15 min and stored frozen in -40°C till analysis.

Analysis Methods

Red blood cells RBC and white blood cells WBC count were measured using haemocytometers. Microhaematocrit method were used for measuring Packed cell volume PCV, platelets was counted by putting the blood samples in anticoagulant tube and measured them in automated platelet count device .

Renal function test were done on a multi chemical fully automated chemistry analyzer using diverse reagent kit, urea measurement was done via enzymatic (urease) kinetic method, jaffe kinetic method was used for creatinine measurment. For the determination of serum uric acid, enzymatic (uricase) method was done. Liver function tests were determined on the same instrument by kinetic method using commercially available kits from randox (france), measurement of ALT, AST and ALP were done using enzymatic (colorimetric method) and bilirubin was done by

DPD- method, serum albumin and total protein concentration, serum level of fasting blood glucose (FBG), total cholesterol (TC), and triglycerides (TG) were determined by linear chemicals S.L. (Joaquim costa 18 2^a planta. 08390 Montgat, Barcelona, Spain).

The plasma concentration of sodium, potassium, calcium and phosphate were measured photometrically using kits from Roche Diagnostic (Mannheim, Germany).

STATISTICS

Mean and standard deviations were calculated. All the statistical analysis was performed using SPSS ver. 20.0. Student's t-test was used to analyze the differences parameters between both groups. P value < 0.05 was considered as significant.

RESULTS

Fifty patients were recruited in this study, 20 males and 30 female aged 23-56 years, the patients were under steady haemodialysis treatment at Al-Hayat Dialysis Center in Al-Karama Teaching Hospital.

Oral gum Arabic intake significantly decreased serum urea, creatinine, uric acid, calcium and sodium concentration $p \leq 0.05$, and significantly increased serum phosphors and potassium concentration $p \leq 0.05$ after six month of treatment with GA (Table 1).

Table 1: Effect of GA supplementation on renal parameters (n=50)

Parameter	Baseline level	Follow-up level
Urea (mg/dl)	65.4±10.4	18.5±2.7*
Creatinine (mg/dl)	13.7±4.2	0.93±0.53*
Uric acid (mg/dl)	10.9±3.3	5.1±1.5*
Calcium (mg/dl)	7.3±0.6	8.9±0.2*
Phosphors (mg/dl)	7.9±0.6	4.01±0.48*
Sodium (mmol/L)	132.1±3.1	142±2.1*
Potassium (mmol/L)	8.1±0.7	4.11±0.32*

GA supplementation for six month significantly decreased serum ALT, AST,ALP and total bilirubin levels $p \leq 0.05$ and significantly increased serum total protein and albumin no significant change was noticed in globulin level $p \leq 0.05$ (Table 2).

Table 2: Effect of GA supplementation on liver function tests (n=50)

Parameter	Baseline level	Follow-up levellevel
ALT (U/L)	39.2±4.13	21.8±2.17*
AST (U/L)	34.52±4.13	25.8±2.28*
ALP (U/L)	198±46.1	85.9±3.26*
Total protein (g/dl)	6.5±0.29	7.47±0.33*
Albumin (g/dl)	3.2±0.33	4.45±0.39*
Globulin(g/dl)	3.3±0.22	3.02±0.29
Total bilirubin (mgdl)	1.66±0.39	0.86±0.25 *

GA oral intake for six month significantly increasd RBCs, platelets, PCV $p \leq 0.05$ and significantly decreased serum glucose, cholesterol and triglyceride levels $p \leq 0.05$, no significant change was found in WBCs count (Table 3).

Table 3: Effect of GA supplementation on blood parameters, glucose, cholesterol and triglycerides level (n=50)

Parameter	Baseline level	Follow-up After 6 months level
RBCs ($10^6/\mu\text{l}$)	3.66±0.32	4.92±0.36*
WBCs ($10^3/\mu\text{l}$)	6.9±0.4	7.2±0.5

Platelets($\times 10^9/L$)	198.2 \pm 20.5	307.5 \pm 31.2*
PCV%	31.51 \pm 3.01	42.21 \pm 4.12*
Glucose (mg/dl)	148 \pm 10.8	101.81 \pm 8.1*
Cholesterol (mg/dl)	178 \pm 8.4	147 \pm 9.6*
Triglycerides (mg/dl)	169 \pm 7.5	139.6 \pm 6.64*

DISCUSSION

The results of the study showed that the oral intake of GA for six month significantly improve the kidney function test by significantly decreasing urea, creatinine and uric acid concentration when compared to the baseline. GA oral administration provide many health benefits such as prebiotic effects [18]. The intestinal microbiome represent an important target for therapeutic interventions in chronic kidney diseases patients[19]. Addition of GA to the food has been revealed to increase the excretion of fecal nitrogen and decrease the concentration of serum urea nitrogen in patients with chronic kidney disease and this was revealed to be reliant on increased bacterial growth and activity in the gastrointestinal tract, colonic bacteria produce urease which hydrolyze urea to ammonia plus carbon dioxide, the resulting ammonia can then be combined into bacterial proteins which are excreted in the bacterial mass portion of the feces[20]. Bliss et al. [21] revealed that enhancing the diet of CRF patients with GA fiber (50g/day) increased the mass of fecal bacteria by 50%, increased the content of fecal nitrogen by 41% and reduced the concentration of blood urea by 12%. Fermentable natural fiber of gum Arabic operate as probiotics increases the mineral absorption especially calcium and help to keep a healthy balance of bacteria in the gut, extraction and reprocessing nitrogenous wastes like ammonia, urea and uric acid[22]. The results also show significant rise in calcium and sodium concentration and significant decrease in phosphorus and potassium concentration in patients after oral intake of GA for six month. The high calcium contents in GA (1,074 mg per 100 g) [9] was possibly the main factor that led to the significant increase in calcium level[11]. The enhanced calcium intake from GA administration has been shown to decrease blood pressure, stimulate the calcium sensing receptor and subsequent inhibition of sodium, potassium and chlorine co transport in the thick ascending limb [23]. Increased serum phosphorus has been considered an independent risk factor for death in patients with CRF on dialysis therefore, it is necessary to reduce selectivity the intestinal absorption of phosphorus GA acts as phosphate binding agents, is a safe treatment of hyperphosphatemia in the intestinal tract [22]. The decreasing in plasma phosphate concentration increase the ionized calcium concentration in plasma and thus counteracts hyperparathyroidism the main pathophysiological factor in advanced renal disease [24]. Many studies reported the beneficial effects of GA administration on the liver [25,26,27]. the results of the present study showed significant decrease in AST, ALT, ALP and total bilirubin in patients after treatment with GA and significantly increase in total protein and albumin. The decreasing in AST and ALT reflect the protective effect of gum Arabic against hepatocyte injury while the decreasing in ALP and total bilirubin levels the improvement of the

liver excretory function, moreover the increasing in total protein and albumin reflect the good synthetic ability of the liver. Several studies showed the activity of Arabic gum as antioxidant material in liver through increasing the concentration of antioxidant enzymes and decreasing the oxidizing molecules [4,28]. GA lowered the liver enzymes, total protein and albumin in gentamicin- induced liver injury in a rat model by its free radical scavenging properties[29]. Bakr, 2016 [12] showed that the using of GA for 45 consecutive days decreased AST, ALT, ALP and total bilirubin and increased serum albumin and total protein in rats inflected with renal failure. It is well known that the healthy kidneys make a hormone named erythropoietin which stimulates the bone marrow to produce red blood cells, in chronic kidney diseases the kidney was unable to make enough erythropoietin and the bone marrow produces fewer red blood cells, producing anemia. GA shown to increase erythropoietin and ameliorated anemia caused by adenine administration [30]. Elderbi et al. [31] found that the administration of GA for four weeks significantly increased the concentration of hemoglobin and MCHC in rats, but the other erythrocyte parameters, platelet count and WBC count were not significantly increase. The results of the current study showed that there is a significant increase in RBC, platelets count and PCV after administration of GA for six month in CRF patients, this effect of GA may be correlated to its anti-oxidant and anti-inflammatory properties which enable the kidney to produce erythropoietin, also the results show that the administration of GA make a significant decrease in glucose, cholesterol and triglycerides level, GA is highly water soluble and has a low viscosity and have the ability to modify glucose absorption therefore, GA has the ability to reduce glucose level in rats with normal glucose level [32]. Kishimoto et al. [33] indicated that a prevotellaraminocola-like bacterium was the prevalent organism which answerable for the fermentation of GA to propionate which have the ability to induct the key enzymes of cholesterol metabolism hence lowers cholesterol level.

CONCLUSION

GA is a useful natural compound for treatment patients with CRF, it's have the ability to improve kidney and liver function tests in addition to lower serum glucose, cholesterol and triglycerides level. GA also improve blood cells count indicating its ability to treat anemia in those patients.

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