# Evaluation of the Efficacy of Medium Protein Diet, Turmeric and Arabic Gum on Chronic Renal Failure

Ebtesam Fath M. Omar [1] and Doaa Ibrahim Mohamed Kabil [2]

## ABSTRACT

**Renal failure is accompanied by oxidative stress, which is caused by enhanced production of reactive oxygen species and impaired antioxidant defense. Turmeric and Arabic gum have antioxidant activities and medicinal properties. This study aimed to investigate the effect of two levels of turmeric and Arabic gum and their combination in the presence of medium protein diets on rats with chronic renal failure. A total of (54) rats weighting 200 ± 10g were fed on basal diet for 7 days for acclimatization. Rats divided into two main groups, the first main group (n=6) fed on basal diet for 8 weeks (*Negative Control*), while the second main group fed on basal diet containing2 % L- arginine (arginine diet) for 4 weeks to induce chronic renal failure then the second main group divided into 8 subgroups (n =6) for 4 weeks as following: *Subgroup (1):* fed on arginine diet containing 14% protein and used as a positive control group. *Subgroup (2):* fed on arginine diet containing 7% protein, and used medium protein diet group (MPD).*Subgroups (3 and 4):* fed on MPDs containing 3% and 6% Arabic gum, respectively. *Subgroups (5 and 6):* fed on MPDs containing 1% and 2% turmeric, respectively. *Subgroup (7):* fed on MPD containing 3% Arabic gum and 1% turmeric. *Subgroup (8):* fed on MPD containing 6% Arabic gum and 2% turmeric. During the experimental period, rats were weighted weekly, feed intake and body weight gain were recorded. At the end of experimental period, rats were scarified; blood samples were collected centrifuged and frozen until analysis. Creatinine, urea nitrogen and uric acid, total protein, Na, K, AST, ALT, glucose and lipid profile were measured. Our results concluded that, all experimental diets had a positive effect on renal functions and the other complications resulted from CRF either alone or combined with medium protein diet especially with high levels. This effect may be due to antioxidant potential of turmeric and Arabic gum.**

**Keywords: Chronic renal failure- L- arginine- medium protein diet – turmeric –Arabic gum- kidney functions- glucose- lipid profile – liver enzymes.**

## INTRODUCTION

Kidneys are the critical target organs that performed many functions including keeping the blood clean and chemically balanced. Kidney functions depend on the ability of the kidneys to filter blood that is estimated using glomerular filteration rate. Progressive loss of kidney functions leads to chronic renal failure (Gerich *et al.* 2001). Chronic kidney disease is characterized by inability of kidney function to return to normal after acute kidney failure or progressive renal decline from disease (National Kidney Foundation, 2000). Chronic renal failure is defined by the presence of a marker of kidney damage, such as increasing of renal functions or a decrease glomerular filtration rate for three or more months (Christoph *et al*. 2002 and Hsu *et al*. 2004).

Arginine is classified as semiessential amino acid because the ability of the body to synthesize sufficient quantities to meet its needs which varies according to development age and incidence of disease or injury. L-arginiecanbe catabolized in mammalian cell: nitric oxide synthesis, arginase, arginie: glycine amidiotransferase and arginine decarboxilase (Morris, 2004).Similarly, Baylis, (2006) confirmed that L-arginine/nitric oxide pathway increased in liver and kidney diseases. The increased in nitric oxide production is attributed to dietary arginine and that causes renal failure. Dietary protein restriction affected positively the progression of renal disease (Pedrini *et al*. 1996) that may reduce decline in renal functions (Eyre *et al*. 2008), alleviates uremic symptoms (Maroni and Mitch 1997), and delay dialysis therapy (Brunori *et al.* 2007). Medium protein diet ameliorate inflammation; suppresses oxidative stress and proteinuria (Kim *et al*. 2010).

Arabic gum is an edible, dried sticky exudates from *Acacia senegal (Leguminosae*) (Younes *et al.* 1995). It is commonly used in food industry and pharmaceutical field as an emulsifier and preservative that rich in non-viscous soluble fiber (Ali *et al*. 2009). Arabic gum has long been used in Arab folk medicine to reduce both the frequency and the need for hemodialysis in patients with chronic renal failure. Additionally, Arabic gum has been shown to reduce urinary nitrogen excretion by increasing urea disposal in the cecum and lowers serum urea concentration in rat and human (Bliss *et al*. 1996), and has antioxidant properties that reduce nephrotoxicity against gentamicine(Al-Majed *et al*. 2002).

Turmeric (*Curcuma longa L.)* is a rhizomatous of the Zingiberaceae family, which is widely used as a

[1]Home Economic Dept., Faculty of Specific Education, Alex. University, Egypt
[2]Home Economic Dept., "nutrition &Food science" Faculty of Specific Education, Tanta University, Egypt.
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spice and coloring agent and for its medicinal properties (Luthra *et al* 2001) as anti-cancer, anti-diabetic, liver protecting, antioxidant, anti-inflammatory, anti-bacterial (Prasad and Aggarwal 2011) and its biological activities (Joe *et al*. 2004). Turmeric is considered a strong antioxidant agent (Banerji and Banergee 2016 and Rozan et al. 2018) due to its content of phenolic compound as curcuimin, demethoxycurcumin, and bisdemethoxycurcumin (Kulkarni *et al*. 2012).There is a dearth of information providing scientific support for improvement of chronic renal failure by different supplements as turmeric and Arabic gum either individual or combination with medium protein diet. So current study was undertaken to investigate the role of medium protein diet, turmeric and Arabic gum against L- arginine –induced chronic renal failure.

## MATERIALS AND METHODS

### Materials:

Casein, minerals, vitamin mixture, cholin chloride and L-arginine were obtained from El- Gomhoria Company. Arabic gum *Acacia Senegal*, turmeric, corn starch, soybean oil and sucrose were purchased from local market, Cairo, Egypt. Adult male albino rats of *Sprague Dawley* strain were obtained from the Animal Colony, Food Technology Research Institute, Agriculture Research Center, Giza, Egypt.

### Methods:

### Biological evaluation

A total of (54) rats weighting 200 ± 10g were fed on basal diet for 7 days for acclimatization. Rats were divided into two main groups, the first main group (n=6) fed on standard diet for 8 weeks (*Negative Control*), while the second main group fed on basal diet containing2 % L- arginine (arginine diet) were for 4 weeks to induce chronic renal failure (Yokozawa *et al.* 2003), then the second main group divided into 8 subgroups (n =6) for 4 weeks according to the following scheme:*Subgroup (1):* fed on arginine diet containing 14% protein and used as a positive control group.*Subgroup (2):*fed on arginine diet containing 7% protein, and used as medium protein diet group (MPD). *Subgroups(3 and 4):* fed on MPDs containing 3% and 6% Arabic gum, respectively. *Subgroups (5 and 6):* fed on MPDs containing 1% and 2% turmeric, respectively. *Subgroup (7):* fed on MPD containing 3% Arabic gum and 1% turmeric. *Subgroup (8):* fed on MPD containing 6% Arabic gum and 2% turmeric. During the experimental period, rats were weighted weekly and feed intake was recorded daily. At the end of the experiment, body weight gain (BWG %) was determined according to (Chapman *et al.* 1959).

At the end of the experiment period, rats were fasted overnight, then the rats were anaesthetized and sacrificed, and blood samples were collected from the aorta in dry centrifuge tube. The blood samples were centrifuged and serum was separated to estimate some biochemical parameters i.e. serum urea nitrogen according to Henry *et al.* (1974), uric acid content in serum according to the method described by (Haisman and Muller 1977), creatinine (Bartels and Bohmer 1971), L- Aspartate amine transferase (AST) and L-Alanine amine transferase (ALT) activities (Reitman and Frankel 1975), total cholesterol (Richmond, 1973), Triglycerides (Wahalefeld 1974), high density lipoprotein- cholesterol HDL- C (Richmond method 1973), low density lipoprotein- cholesterol LDL-C and very low density lipoprotein-cholesterol VLDL-C (Hatch and Lees 1986), Serum glucose(Trinder, 1969), serum sodium was measured according to the colorimetric method of (Henry *et al.* 1974) and serum potassium was measured according to the colorimetric method of Henry (1964).

Kidneys were separated from each rat and weighted to calculate the kidney weight to body weight %.The statistical analysis was carried out by using SPSS, PC statistical software (version 10.0; SPSS Inc, Chieago, USA). The results expressed as mean ± SD. Data analyzed by one-way analysis of variance (ANOVA). The Differences between means were tested for significance using least significant difference (LSD) test at ($P<0.05$) (Steel and Torri, 1980).

## RESULTS AND DISCUSSION

Effect of medium protein diet containing two levels from turmeric, Arabic gum and their combination on feed intake, body weight gain% and kidney weight/body weight% of rats suffering from chronic renal failure presented in Table (1). Long term feeding of L- arginine to rats produced significant decrease $p\leq0.05$ in feed intake, as compared to negative control group as indicated by Yokozawa *et al*. (2003). All experimental diets showed significant improvement in feed intake, as compared to CRF rats except rats fed on medium protein diet (MPD) only, which showed non-significant differences, as compared to CRF rats. On the other hand, the highest feed intake value was observed in CRF fed on MPD containing2% turmeric, followed by MPD containing 1% turmeric respectively. This effect is may be due to the flavor of turmeric, which improve appetite of rats. These results are in agreement with findings of Lee *et al*. (2016) who confirmed that, supplementation of turmeric extract improved feed intake in CCL4 treated rats.

**Table 1. Effect of medium protein diet containing two levels from turmeric, Arabic gum and their combination on nutritional parameters and kidney weight of chronic renal failure rats**

| Groups \ Parameters | Feed Intake (g/day/rat) | Body weight gain BWG % | Kidney weight / body weight% |
|---|---|---|---|
| Control (-ve) | 17.833[a] ±1.169 | 28.510[a] ± 1.909 | 0.438[g] ± 0.036 |
| Control (+ve) | 13.000[f] ± 0.894 | 9.325 [e] ± 1.190 | 0.905[a] ± 0.074 |
| CRF fed on MPD Only | 13.666[e f] ± 0.516 | 15.525[d] ± 0.979 | 0.758[b] ± 0.046 |
| CRF fed on MPD Containing 3% Arabic gum | 14.500[cd e] ± 0.547 | 17.595[bc] ± 0.967 | 0.640[c] ± 0.052 |
| CRF fed on MPD Containing 6% Arabic gum | 14.166[de] ± 0.752 | 16.101[c d] ± 0.851 | 0.563[d e] ± 0.056 |
| CRF fed on MPD Containing 1% turmeric | 15.166[b c] ± 0.750 | 17.585[b c] ± 1.450 | 0.593[c d] ± 0.041 |
| CRF fed on MPD Containing 2% turmeric | 15.500[b] ± 0.547 | 18.630[b] ± 1.224 | 0.525[e f] ± 0.044 |
| CRF fed on MPD Containing 3% Arabic gum and 1% turmeric | 14.666[bc d] ± 0.816 | 17.721[b] ± 0.968 | 0.517[ef] ± 0.007 |
| CRF fed on MPD Containing 6% Arabic gum and 2% turmeric | 14.166[de] ± 0.752 | 17.151[bc] ± 0.748 | 0.486[f g] ± 0.024 |

CRF: Chronic Renal Failure MPD: Medium Protein Diet

Values are expressed as means ± SD.

Values at the same column with different letters are significant at P<005.

With respect to body weight gain% (BWG %), CRF rats showed significant decrease p≤0.05 in BWG%, as compared to negative control group because of progressive weakness, weight loss, diarrhea and excessive muscle protein catabolism resulting in negative nitrogen balance (Yokozawa *et al*. 2003 and Giebisch 2007). While, significant increases were observed in body weight gain% in all treated groups ,as compared to CRF rats especially MPD containing 2% turmeric and CRF group fed on MPD containing 3% Arabic gum and 1% turmeric, respectively. The possible reason for increasing BWG% might be due to increase in food intake. This effect was due to the presence of curcumin; the main ingredient of turmeric (Nayeri *et al*. 2017) which was due to the secretion of mucin which protect gastrointestinal tract against irritation and enhances intestinal lipase, sucrose and maltase activity ( Lee *et al.* 2003 and Platel *and* Srinivasan 1996). Recently, Lee *et al*. (2016) confirmed that, supplementation of turmeric extract improved body weight gain in CCL4 treated rats. In addition, Arabic gum increased weight gain in normal rats (Eqbal and Aminah 2014).

In concern with relative kidney weight, significant increase in the mean value of relative kidneys weight of L- arginine – fed rats were observed, as compared to negative control group. This, could be attributed to an increase in activity of inflammation of kidney tissue. All experimental diets resulted in marked reductions in relative kidney weight especially higher doses of (turmeric and Arabic gum) and the best result was recorded in MPD containing 6% Arabic gum and 2% turmeric. This effectiveness can be explained by anti-inflammatory properties of turmeric and Arabic gum as demonstrated by Peter, (2000) who mentioned that turmeric is a good anti-inflammatory agent. Similarly, Antonyan *et al.* (2014) and Banerji and Banerjee (2016) demonstrated that turmeric has anti-inflammatory properties. Accordingly, our obtained results confirmed that treatment of CRF rats with supplementation of MPD containing 2% turmeric agreed fairly with the results of Shivanoor and Dvid (2014) who concluded that feeding on turmeric- diet produced significant improvement in body weight gain and relative kidney weight in deltamethrin treated rats. Restriction in dietary protein intake was effective in decreasing inflammation and, suppressing oxidative stress (Kim *et al*. 2010). Moderate protein restriction improved oxidative stress and inflammation in Remnant Kidney Model (Tai and Ding 2010).

Effect of medium protein diet containing two levels from turmeric, Arabic gum and their combination on serum uric acid, urea nitrogen and creatinine of rats suffering from chronic renal failure illustrated in Table (2). Previous studies have resulted in considerable

discussion of the link between renal diseases and oxidative stress, which lead to excessive generation of oxygen derived free radicals. These free radicals are highly reactive and injured lipids, protein, and nucleic acid resulting in structural and functional impairment (Schrier *et al*. 1988 and Yokozawa *et al*. 2003). Elevation in renal functions as a result of oxidative stress which plays a crucial role in the development in L-arginine – induced chronic renal failure. Impairment in radical- scavenging system in rats fed on L-arginine diet by decreasing in antioxidant activities has been demonstrated by (Yokozawa *et al*. 2003). Similarly, Sanders, (1995) reported that feeding on L-arginine-diet resulted in a progressive loss in renal functions. At the same subject, Baylis, (2006) confirmed that alteration in nitric oxide pathway is higher in L- arginie –fed rats as compared to casein –fed rats.

From our obtained results, it could be noticed that rats with chronic renal failure by administration of L-arginine- diet produced significant impairment in renal functions, represented by significant increases in serum uric acid, urea nitrogen and creatinine levels as compared to negative control. As indicated by (Lee and Nieman, 1996 and Rahman *et al*. 2001) who reported that creatinine is known as a good indicator of renal functions; higher levels of creatinine mean there is obvious damage to functional nephrones. Current study indicated that all treated groups showed highly significant reductions in all biomarkers of renal functions including (uric acid, urea nitrogen and creatinine) in comparable to CRF rats. Supplementation with MPD with combination of (6% Arabic gum and 2% turmeric) showed highly significant reductions in renal functions in comparable to other treated groups and CRF rats.

These results were in consistent with earlier findings which confirmed that restriction in dietary protein intake has antioxidant effect in CKD in animals and human (Nankivell *et al*. 1994 and Stenvinkel *et al*. 1998), effective in improvement of renal functions (Eyre *et al*. 2008) and delaying the progression of renal disease and dialysis therapy (Brunori *et al.* 2007). Medium protein diet ameliorates inflammation, suppresses oxidative stress and reduces proteinuria in chronic renal failure rats (Kim *et al.* 2010).

Moderate protein restriction improved oxidative stress, inflammation in Remnant Kidney Model (Tai and Ding 2010). In this sense, (Castaneda *et al.* 2013) reported that restriction in dietary protein intake, as low protein diet can be effective to reduce uremia in patients with chronic renal failure. Recently, feeding on medium protein diet significantly reduced renal failure by 42% in diabetic elderly with chronic kidney disease (Giordano *et al.* 2014).

**Table 2. Effect of medium protein diet containing two levels from turmeric, Arabic gum and their combination on kidney functions of chronic renal failure rats**

| | Parameters | Kidney functions (mg/dl) | | |
|---|---|---|---|---|
| Groups | | Uric acid | Urea nitrogen | Creatinine |
| Control (-ve) | | 1.265$^{h}$ ± 0.038 | 26.295$^{h}$ ± 1.595 | 0.563$^{h}$ ± 0.029 |
| Control (+ve) | | 3.486$^{a}$ ± 0.098 | 67.105$^{a}$ ± 3.248 | 2.816$^{a}$ ± 0.104 |
| CRF fed on MPD | Only | 2.991$^{b}$ ± 0125 | 61.598$^{b}$ ± 3.265 | 2.425$^{b}$ ± 0.073 |
| | Containing 3% Arabic gum | 2.555$^{c}$ ± 0.126 | 55.103$^{c}$ ± 3.510 | 2.025$^{c}$ ± 0.094 |
| | Containing 6% Arabic gum | 2.061$^{e}$ ± 0.064 | 45.696$^{e}$ ± 2.315 | 1.561$^{e}$ ± 0.114 |
| | Containing 1% turmeric | 2.301$^{d}$ ± 0.137 | 50.631$^{d}$ ± 3.447 | 1.855$^{d}$ ± 0.057 |
| | Containing 2% turmeric | 1.888$^{f}$ ± 0.117 | 41.481$^{f}$ ± 1.987 | 1.328$^{f}$ ± 0.100 |
| | Containing 3% Arabic gum and 1% turmeric | 2.008$^{ef}$ ± 0.133 | 42.633$^{ef}$ ± 1.824 | 1.493$^{e}$ ± 0.047 |
| | Containing 6% Arabic gum and 2% turmeric | 1.533$^{g}$ ± 1.225 | 36.466$^{g}$ ± 2.080 | 1.066$^{g}$ ± 0.108 |

CRF:Chronic Renal Failure MPD:Medium Protein Diet

Values are expressed as means ± SD.

Values at the same column with different letters are significant at P<0.05.

Ki Haw and Keum Ran (2005) reported that curcumin produced improvement in renal functions by reducing levels of urea nitrogen and creatinine in CCl4 treated rats. Recently, (Rozan et al. 2018) mentioned that curcumin has antioxidant activity. Also, Shivanoor and David (2014) presumed that treatment of turmeric diet produced significant reductions in serum urea nitrogen, creatinine and uric acid levels in deltamethrin treated rats and improved antioxidant enzymes. Similarly, Khajehdehi *et al*. (2012) reported that turmeric has antioxidant activity and slowing the progression of chronic kidney diseases. This antioxidant effect of turmeric due to its content of flavenoids which acts as antioxidant agent (Gills 1992), and phenolic compounds (Naksuriya *et al*. 2014) . Moreover, Biswas *et al* . (2005) reported that turmeric has antioxidant activity by modulating GSH levels scavenging oxygen free radicals. In addition, turmeric inhibits oxidative damage in mice, increases antioxidant enzymes, improves kidney tissue and repairs histological alterations of kidney (Shivanoor and David 2014).

Similarly, Arabic gum lowered urinary nitrogen excretion by increasing urea disposal in the cecum and lowers serum urea concentration in rat and human (Bliss *et al*. 1996). Arabic gum has antioxidant capacity and nephroporotective effect that is why it has been demonstrated in folk medicine to decrease need to hemodialysis in chronic renal failure patients and reduce nephrotoxicity against gentamicin (Al-Majed *et al*. 2002). Mahmoud *et al*. (2012) demonstrated that supplementation of Arabic gum improved renal dysfunction in adenine-induced chronic renal failure by decreasing serum creatinine, urea nitrogen and uric acid.

Experimentally, Arabic gum has been demonstrated as a strong antioxidant that improved renal functions (Ali *et a*l. 2013), clinically, Arabic gum has been used in chronic renal failure patients. In addition, Ahmed *et al*. (2015) reported that Arabic gum acts as a strong antioxidant against reactive oxygen species by increasing superoxide dismutase, catalase and glutathione peroxidase and decrease in gmalondialdehyde.

The effect of medium protein diet containing two levels from turmeric, Arabic gum and their combination on serum protein, Na and K of chronic renal failure rats presented in Table (3).

**Table 3. Effect of medium protein diet containing two levels from turmeric, Arabic gum and their combination on serum protein, Na and K of chronic renal failure rats**

| Groups / Parameters | | Protein (g/l) | Na mmol/l | K mmol/l |
|---|---|---|---|---|
| Control (-ve) | | 6.321$^{g}$ ± 0.105 | 130.051$^{a}$ ± 3.849 | 3.408$^{h}$ ± 0.087 |
| Control (+ve) | | 7.832$^{a}$ ± 0.110 | 99.873$^{g}$ ± 3.812 | 5.805$^{a}$ ± 0.127 |
| CRF fed on MPD | Only | 7.533$^{b}$ ± 0.062 | 106.116$^{f}$ ± 3.639 | 5.215$^{b}$ ± 0.145 |
| | Containing 3% Arabic gum | 7.330$^{c}$ ± 0.071 | 111.383$^{e}$ ± 2.942 | 4.578$^{c}$ ± 0.125 |
| | Containing 6% Arabic gum | 6.861$^{e}$ ± 0.030 | 116.423$^{c d}$ ± 3.944 | 4.143$^{e}$ ± 0.085 |
| | Containing 1% turmeric | 7.131$^{d}$ ± 0.086 | 114.018$^{d e}$ ± 3.076 | 4.313$^{d}$ ± 0.061 |
| | Containing 2% turmeric | 6.857$^{e}$ ± 0.061 | 118.936$^{c}$ ± 3.281 | 3.938$^{f}$ ± 0.074 |
| | Containing 3% Arabic gum and 1% turmeric | 6.710$^{f}$ ± 0.042 | 117.953$^{c d}$ ± 1.880 | 4.073$^{e}$ ± 0.088 |
| | Containing 6% Arabic gum and 2% turmeric | 6.412$^{g}$ ± 0.130 | 123.893$^{b}$ ± 2.770 | 3.638$^{g}$ ± 0.121 |

Na: Sodium K: Potassium
CRF:Chronic Renal Failure MPD:Medium Protein Diet
Values are expressed as means ± SD.
Values at the same column with different letters are significant at P<0.05.

Adverse effects of chronic renal failure is proteinuria; as demonstrated by earlier study of Adams *et al*. (1994) who reported that feeding on high amount of protein significantly increased glomerular filtration rate and proteinuria. That is why; chronic administration of L- arginine produced elevated serum total protein in combatable to negative control group. Serum total protein levels were significantly decreased in all experimental diets, as compared to CRF rats especially higher doses of Arabic gum and turmeric when supplemented to MPD. The best result was recorded in experimental MPD containing 6% Arabic gum and 2% turmeric. These results are in going along with Trachtman *et al*. (1996) who mentioned that treatment with antioxidant improved renal functions and decreased protein urea, likewise, Chan *et al*. (1998) demonstrated that higher doses of antioxidant reduced proteinuria.

Also, Ali *et al*. (2013) who mentioned that administration of Arabic gum significantly reduced proteinuria in adenine- induced chronic renal failure in rats. Other metabolic abnormalities of chronic renal failure is hyponatremia (Henry *et al*. 1991). Also, Hilton *et al*. (1998) reported that patients with chronic renal failure have lower excretion of potassium (hyperkalemia) and higher excretion of sodium (hyponatremia).With respect to our results indicating the relationship between sodium and potassium in chronic renal failure rats and treated groups. From obtained results, it could be deduced that chronic administration of L- arginine caused abnormal changes in serum sodium and potassium levels as compared to negative control group. All treated rats showed significant differences as rising of sodium and reduction in potassium values as compared to CRF untreated rats. Treatment with feeding on (MPD containing 6% Arabic gum and 2% turmeric) and (MPD containing 3% Arabic gum and 1% turmeric)showed highly significant improvement respectively as compared to positive control group.

These results are in line with those obtained by Hus and Chertow (2002) who mentioned that patients with chronic renal failure have metabolic acidosis, which induces efflux potassium (K+) from cells. Also, Nguyen and Krutz (2005) and Giebisch (2007) who revealed that elevated levels of serum potassium are related to chronic renal failure. Moderate protein diet does not lead to malnutrition and ameliorates metabolic acidosis (Eyre *et al*. 2008). Restriction in dietary protein intake was effective in, suppressing oxidative stress and reducing proteinuria (Kim *et al*. 2010). In this sense, moderate protein restriction improved oxidative stress, and proteinuria in Remnant Kidney Model (Tai and Ding 2010).

Data in Table (4) showed the effect of medium protein diet containing two levels from turmeric, Arabic gum and their combination on serum glucose and liver enzymes of rats suffering from chronic renal failure.

The relationship between oxidative stress and progression of hyperglycemia was reported by (Curcio *et al*. 1995). Yokozawa *et al*. (2003) demonstrated that administration of L-arginine produced elevation of glucose levels as complication of chronic renal failure. From the obtained results, serum glucose levels were significantly increased in L-arginine fed-rats, as compared to negative control group. Obviously, uncontrollable increase in serum total cholesterol and triglycerides lead to excessive increase in serum glucose level.

All experimental diets regulated the elevation of serum glucose levels except treatment with MPD only, which showed no significant reduction in serum glucose levels, as compared to CRF rats. The strongest action against the elevation of serum glucose levels was recorded in CRF rats treated with MPD containing 6 % Arabic gum and 2% turmeric. It was remarkable that the higher doses were effective than lower doses. Our results are consistently agreed with previous studies by Giordano *et al*.(2014 )who confirmed that medium protein diet (MPD) did not affect glycaemia in diabetic patients, and did not change glucose metabolism in both animals and humans (Mudaliar and Henry 1996 and Arimura *et al.* 2013).

These results are in harmony with those obtained by Laquatra and Gerlach (1990) who demonstrated that other complications of chronic renal failure is glucose intolerance due to the prepheral tissue resistance to insulin action. Similarly, Evans *et al.* (2002) emphasis the relationship between oxidative stress and insulin resistance due to hyperglycemia. Recently, Banerji and Banerjee (2016) mentioned that turmeric decreased blood glucose level, has hypoglycemic effect, and helps controlling type 2 diabetes mellitus in advanced – stage patients by its effect as a strong antioxidant that inhibits oxidative stress, inflammation and immune dysfunctions. This positive effect of turmeric due to improvement of antioxidant enzyme activities (Robertson, 2009).The reduction in serum glucose level by Arabic gum is may be due to its content of dietary fiber, which associated with lowering caloric density of food (Schneeman 1987).Recently, Nasir (2014) reported that Arabic gum reduced serum glucose by decreasing glucose absorption.

**Table 4.Effect of medium protein diet containing two levels from turmeric, Arabic gum and their combination on serum glucose and liver enzymes of chronic renal failure rats**

| Groups | Parameters | Glucose mg/dl | Liver enzymes (U/L) AST | Liver enzymes (U/L) ALT |
|---|---|---|---|---|
| Control (-ve) | | 83.203 [f] ± 3.025 | 58.521[h] ± 1.869 | 20.763 [g] ± 1.457 |
| Control (+ve) | | 145.010 [a] ± 5.724 | 103.021 [a] ± 4.035 | 60.610 [a] ± 3.423 |
| CRF fed on MPD | Only | 147.928 [a] ± 5.973 | 94.948[b] ± 3.645 | 55.370[b] ± 3.555 |
| | Containing 3% Arabic gum | 138.228[b] ± 5.721 | 87.036[c] ± 2.957 | 49.836[c] ± 4.328 |
| | Containing 6% Arabic gum | 128.605 [c] ± 3.761 | 77.205[e] ± 2.782 | 43.648 [d e] ± 2.876 |
| | Containing 1% turmeric | 135.171 [b] ± 5.022 | 82.686[d] ± 3.179 | 46.316 [c d] ± 3.607 |
| | Containing 2% turmeric | 121.695 [d] ± 2.838 | 72.775[f] ± 2.486 | 40.506 [e] ± 3.304 |
| | Containing 3% Arabic gum and 1% turmeric | 124.085 [c d] ± 4.334 | 76.443[ef] ± 3.639 | 41.255 [e] ± 2.793 |
| | Containing 6% Arabic gum and 2% turmeric | 106.628 [e] ± 3.858 | 65.928[g] ± 3.731 | 35.198 [f] ± 11.449 |

CRF: Chronic Renal Failure MPD :Medium Protein Diet

Values are expressed as means ± SD.

Values at the same column with different letters are significant at P<0.05.

Most of earlier studies demonstrated that chronic renal failure is associated with impairment of causes multi-organ disturbance especially liver functions as elevation of ALT and AST enzymes (Mariusz *et al*. 1996; Yokozawa *et al*. 2003 and Kawai *et al.* 2006). With respect to liver functions, it could be observed that CRF rats produced significant increase in serum AST and ALT enzymes in comparable to healthy rats. Administration of all tested diets revealed significant reductions of AST and ALT enzymes. It could be stated that the higher doses of Arabic gum and tumeric were effective than the lower doses when they supplemented to MPD.

These results are in keeping with previous study by Ki Haw and Keum Ran( 2005) who reported that curcumin reduced hepatotoxicity by improvement of liver function in CCl4 treated rats. Recently, Lee *et al*. (2016) indicated that hepatic damage improved by treatment of turmeric extract as it regulated serum ALT and AST, indicating liver protection. By inhibition of oxidative stress and formation of reactive oxygen species (Behrman *et al*. 2001). At the same subject, curcumin, the main ingredient of turmeric has medicinal properties that it has protective effect against liver disease (Nayeri *et al.* 2017) by decreasing expression of intestinal cytochrome P450 3A (Zang *et al*. 2007).

Treatment of diabetic rats with Arabic gum significantly reduced liver alanine transaminase (ALT) and aspartate transaminase (AST) activity (Ahmed *et al.* 2015), this effect is may be due to antioxidant capacity of Arabic gum, which cause stability of cell membrane and protection of enzyme leakage (Thabrew *et al.* 1987).

Results in Table (5) showed the effect of medium protein diet containing two levels from turmeric, Arabic gum and their combination on lipid profile including (cholesterol, triglycerides, high density lipoprotein-cholesterol HDL-C, low and very low density lipoprotein-cholesterol (LDL-C& VLDL-c) of rats suffering from chronic renal failure.

From the obtained results, it was observed that; impairment in renal functions in chronic renal failure as a results of L- arginine –fed diet produced some complications as dyslipidemia ; higher values of TC,TG,LDL and VLDL- C and on contrast lower value of HDL-C. These results are in accordance with findings by (Sing *et al*. 2006 and Rutkowski *et al*. 2006).

There were significant reductions in serum TC, TG, LDL-C and VLDL-C values and significant increases in serum HDL-C values in all treated groups as compared to positive control group. It was remarkable that, the

**Table 5. Effect of medium protein diet containing two levels from turmeric, Arabic gum and their combination on lipid profile of chronic renal failure rats**

| Parameters / Groups | Lipid profile (mg/dl) TC | TG | HDL-C | LDL-C | VLDL-C |
|---|---|---|---|---|---|
| Control (-ve) | 82.535 [h] ± 3.926 | 35.686 [g] ± 2.594 | 50.230 [a] ± 2.898 | 25.169 [h] ± 3.828 | 7.136 [g] ± 0.518 |
| CRF (+ve control) | 139.080 [a] ± 3.436 | 70.186 [a] ± 2.859 | 23.896 [h] ± 3.419 | 101.146 [a] ± 4.873 | 14.036 [a] ± 0.571 |
| CRF fed on MPD: Only | 129.741 [b] ± 2.097 | 64.935 [b] ± 2.261 | 28.236 [g] ± 2.874 | 88.503 [b] ± 3.820 | 13.002 [b] ± 0.436 |
| CRF fed on MPD: Containing 3% Arabic gum | 120.125 [c] ± 2.705 | 57.686 [c] ± 3.535 | 33.890 [f] ± 2.943 | 74.697 [c] ± 5.012 | 11.537 [c] ± 0.707 |
| CRF fed on MPD: Containing 6% Arabic gum | 104.575 [e] ± 3.530 | 51.390 [d] ± 2.624 | 37.958 [d e] ± 1.899 | 56.338 [e] ± 4.851 | 10.278 [d] ± 0.524 |
| CRF fed on MPD: Containing 1% turmeric | 113.550 [d] ± 3.021 | 53.081 [d] ± 3.661 | 35.391 [e f] ± 2.292 | 67.542 [d] ± 4.722 | 10.616 [d] ± 0.732 |
| CRF fed on MPD: Containing 2% turmeric | 99.556 [f] ± 3.179 | 46.226 [e] ± 3.767 | 39.961 [c d] ± 1.622 | 50.349 [f] ± 3.907 | 9.245 [e] ± 0.753 |
| CRF fed on MPD: Containing 3% Arabic gum and 1% turmeric | 101.591 [ef] ± 2.725 | 46.775 [e] ± 3.981 | 41.566 [b c] ± 2.077 | 50.670 [f] ± 3.516 | 9.355 [e] ± 0.796 |
| CRF fed on MPD: Containing 6% Arabic gum and 2% turmeric | 90.490 [g] ± 2.494 | 42.476 [f] ± 2.825 | 43.350 [b] ± 1.705 | 38.644 [g] ± 3.347 | 8.495 [f] ± 0.565 |

TC: TotalCholesterol TG: Triglyceride HDL-C: High Density Lipoprotein-Cholesterol
LDL-C: Low Density Lipoprotein-Cholesterol VLDL-C: Very low density lipoprotein-cholesterol
CRF:Chronic Renal Failure MPD:Medium Protein Diet
Values are expressed as means ± SD.
Values at the same column with different letters are significant at $P<0.05$.

higher doses were more effective than the lower. The most hypolipidemic effects were recorded in CRF rats treated with MPD containing 6% Arabic gum and 2% turmeric. These results are in board agreement with the results of Peter (2000) who demonstrated that turmeric has cholesterol-lowering effect. This effect of turmeric is due to its content of saponins, which have cholesterol –lowering effect (Gills, 1992).

Similarly, Ki Haw and Keum Ran( 2005) reported that curcumin improved lipid profile in CCl4 treated rats by decreasing levels of triglycerides, total cholesterol and low density lipoprotein. Recently, Lee *et al*. (2016) revealed that administration of turmeric extract increased hepatic HDL-C in CCl4-induced liver damage by enhancing antioxidation.

Ali *et al.* (2009) reported that, the reduction in serum lipids by Arabic gum is may be due to its content of dietary fiber which associated with the beneficial effect of fat metabolism. Also, Arabic gum in combination between two types of Arabic gum decreased total cholesterol and LDL-C in normal rats (Eqbal and Aminah 2014), this lipid–lowering effect in animal (Gallaher *et al*. 1993) and human (Superko *et al.* 1988) because of its content of non –starch polysaccharides. .Recently, Ahmed *et al.* (2015) confirmed hypolipidemic effect of Arabic gum in diabetic rats due to its dietary fiber.

## CONCLUSION

This study concluded that; treatment of chronic renal failure rats with different experimental diets revealed improvement in biomarkers of CRF rats especially renal and liver functions. The data was recorded strongly with combination of turmeric , Arabic gum and medium protein diet at higher doses.

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## الملخص العربي

## تقييم فعالية النظام الغذائي متوسط البروتين والكركم والصمغ العربي علي الفشل الكلوي المزمن

ابتسام فتح محمود عمر ، دعاء إبراهيم محمد قابيل

الفشل الكلوي هو حدوث خلل في وظائف الكلى نتيجة تكوين الشقائق الحرة التي تسبب خلل في نظام الأكسدة داخل الجسم مما يؤدى إلى حدوث التلف التأكسدي. ويعتبر الكركم والصمغ العربي من المكونات ذات تأثير مضاد للأكسدة ولذلك فهي لها خصائص طبية عديدة. تهدف هذه الدراسة إلى تقييم تأثير مستويين من الكركم والصمغ العربي وخليطهما في وجود الوجبات متوسطة البروتين علي الفئران المصابة بالفشل الكلوي المزمن.استخدمت في هذه الدراسة ٥٤ فأر بالغ من نوع الالبينو أوزانهم ٢٠٠ ±١٠جم، تم تقسيمهم إلي مجموعتين رئيسيتين، الأولي (٦فئران) تم تغذيتها على غذاء أساسي لمدة ٨ أسابيع واستخدمت كمجموعة ضابطة، في حين تم تغذية المجموعة الرئيسية الثانية على غذاء أساسي يحتوى علي ٢% أرجينين (وجبة الارجنين) لمدة أربعة أسابيع لإحداث الفشل الكلوي المزمن. تم تقسيم فئران المجموعة الثانية المصابة إلي ٨ مجموعات فرعية (٦ فئران لكل مجموعة). *المجموعة الفرعية (١)* تم تغذيتها على وجبة الارجينين التي تحتوي علي ١٤% بروتين واستخدمت كمجموعة ضابطة مصابة. المجموعة الفرعية (٢) تم تغذيتها على وجبة الارجينين التي تحتوي على ٧% بروتين واستخدمت كمجموعة متوسطة البروتين. المجموعات الفرعية (٣ و٤) تم تغذيتهم على غذاء متوسط البروتين تحتوي على ٣% و٦% صمغ عربي على التوالي. المجموعات الفرعية (٥ و٦) تم تغذيتهم على غذاء متوسط البروتين تحتو ي على ١% و٢% كركم على التوالي. المجموعة الفرعية (٧) تم تغذيتها على غذاء متوسط البروتين تحتوي على ٣% صمغ عربي و١% كركم. المجموعة الفرعية (٨) تم تغذيتها على غذاء متوسط البروتين تحتوى علي ٦% صمغ عربي و ٢% كركم.وخلال فترة التجربة تم تسجيل وزن الفئران أسبوعيا والمتناول من الغذاء يوميا. وفى نهاية التجربة تم تحليل عينات الدم وتقدير كلا من وظائف الكبد والكلى ومستوى سكر الدم ونسبة البروتين الكلى وأملاح الصوديوم والبوتاسيوم ودهون الدم. وأظهرت النتائج التأثير الايجابي لكل الوجبات المختبرة على وظائف الكلى وتحسن الخلل الناتج عن الفشل الكلوي باستخدام الكركم والصمغ العربي مخلوطا مع وجبة متوسطة البروتين وخصوصا الجرعات الأعلى. ويرجع ذلك التأثير الايجابي إلى التأثير المضاد للأكسدة لكلا من الكركم والصمغ العربي.

الكلمات المفتاحية: فشل كلوى مزمن – ارجينين – نظام غذائي متوسط البروتين – كركم – صمغ عربي – وظائف كلي – جلوكوز – صورة الدهن – انزيمات الكبد.