IOSR Journal of Humanities And Social Science (IOSR-JHSS)
Volume 26, Issue 5, Series 7 (May. 2021) 01-08
e-ISSN: 2279-0837, p-ISSN: 2279-0845.
www.iosrjournals.org

Physicochemical Studies on *Acacia Senegal* Gum, and Their Effect on Uric Acid Levels in Gout Patients.

Ayat S. Hasheim[1], M. H. Awad[2*], and Nouri M. A. Soleiman[2].
[1] *Department of Chemistry, Faculty of Sciences and Technology, Shendi University – Sudan;*
[2] *Department of Chemistry, Faculty of Arts and Sciences - Kasr Khiar, Elmergib University – Libya .*

Abstract
Nine samples of dried exudate *Acacia Senegal* gums collected, and authenticated by studying their physicochemical properties. 50 g per day of *Acacia Senegal* gum was administered orally to patients of difference ages suffering from gout, for three months. Blood samples were collected from each patients, and controls on the first day of administering *Acacia Senegal* gum, and once per month for three months. Uric acid, Urea, Creatinine, and Haemoglobin were measured using standard methods. For males patients of different ages namely M1, M2, M3, M4, M5, M6, M7, and M8, the uric acid levels significantly decreased by 67, 26, 46, 15, 10, 8.0, 43, and 13 % respectively, while for females namely F1, and F2 decreased by 38, and 18% respectively. For above males Urea levels significantly decreased by 15, 13, 41, 10, 30, 14, 6.0, and 9.0 % respectively, while for above females decreased by 17, and 31% respectively. Creatinine level was markedly decreased in patients M1, M2, M3, M4, M5 and M6 by 63, 55, 27, 29, 35, and 45 % respectively, while for males patients namely M5, and M6 there is no statistically significant results obtained. Also for females patients namely F1, and F2 creatinine concentration decreased by 21, and 20 % respectively. There was a significant increase in Haemoglobin levels by 14, 36, 9.0, 20, 29, 30 , 6.0, and 19 % , for males patients namely M1, M2, M3, M4, M5, M6, M7, and M8 respectively. For females patients namely F1, and F2 Haemoglobin levels increased by 18 and 17 %. respectively. From this work, we conclude that oral administration of *Acacia Senegal* gum could conceivably reduce the Gout pains by decreases levels of uric acid in the blood.
Key words: *Acacia Senegal*; Uric acid; Urea; Creatinine; Haemoglobin **.**

Date of Submission: 04-05-2021 Date of Acceptance: 18-05-2021

I. INTRODUCTION

Polysaccharide gums obtained from varieties of *Acacia* species are used extensively in food 'additive', pharmaceutical industries, and other industrial applications [1], in last decades *Acacia Senegal* gum used as suspending agent, also was prescribed for Chronic renal failure patients in Sudan, resulting in decreased both uric acid, and uremia, then reduction in the frequency of dialysis [2 - 4], where, it was observed to decrease urinary nitrogen secretion by raising the urea disposal in the cecum, and decreases urea concentration in human [2,5], also *Acacia Senegal* gum has been shown to reduce other purine metabolites. The mechanism by which *Acacia Senegal* gum ameliorates chronic renal failure is uncertain [6]. Gout is defined as the pathological reaction of joint or specific tissue to the precipitated crystals of monosodium urate monohydrate (MSU), the crystals of MSU that precipitate in and around connective tissues in synovial joints and favoring lower limbs joints than upper limb and especially proximal metacarpal joints and small joints of the feet. Gout is classified as primary, a condition due to excessive production of purines resulting in renal retention of uric acid. Which is, directly, associated with the deficiency of the enzymes, Xanthine dehydrogenase, Adenine phospho-ribosyl transfers, and Hypoxanthine guanine phospho-ribosyl transferase [7,8]. Secondary gout is characterized by elevated levels of uric acid encountered, most often, in males over the age of thirty. However, females are less subject to secondary gout. Gout is also associated with obesity (hyperlipidemia), hypertension, excessive alcohol intake, diuretic therapy and old age. Elevated serum uric acid concentrations greater than 7 mg /dl causes Urate crystals to develop with time causing, in the long run, impaired renal function, and osteoarthritis [9] . Elevated Erythrocyte Sedimentation Rate (ESR) is another symptom associated with acute gout. ESR is used to monitor elevated serum protein associated with disease, such as Temporal artheritis, Polymyalgia rheumatica and Rheumatoid artheritis and other autoimmune disorders [10]. ESR, however, is useful in the diagnosis of inflammatory conditions associated with body reaction to harmful (injurious) stimuli [11]. The aim of this work is to authenticate the samples of *Acacia Senegal* gum by investigate their physicochemical properties and comparing the results with international standard limits. Also to investigate the effect of *Acacia*

Senegal gum on uric acid levels in gout patients. And find the best time to cut the level of uric acid in the blood to relieve of symptoms of the disease.

II. ORIGIN OF SPECIMENS

Authentic specimens of exudate *Acacia Senegal* gums collected by Dr. M. H. Awad from authenticated, numbered of Hashab trees in Blue Nile State - Sudan.

2.1 Purification and Preparation of samples

Acacia Senegal gum samples (Fig.1) used for these studies were first freed from foreign materials, dried under room shade, and then ground into fine powder by using an electric mill to pass 0.4 mm mesh screen. The prepared samples were kept in tight containers and stored at room temperature until analysis.

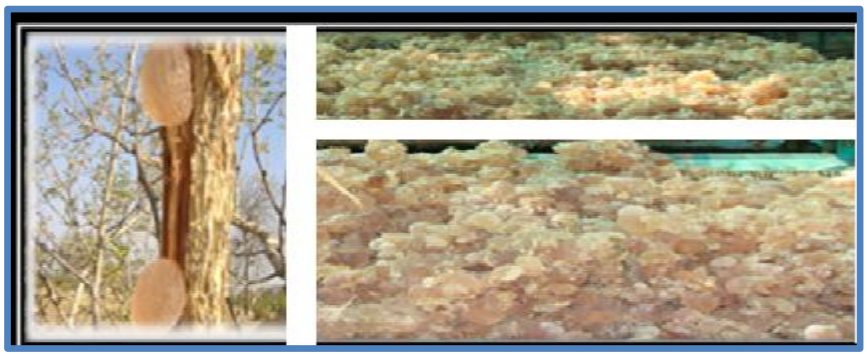

Fig.1 Nodules of Acacia Senegal Gum

2.2 Standard methods of analysis to determine physicochemical properties were used to authenticated the gum arabic samples used in studies [12].

2.3 Effect of *Acacia Senegal* gum in uric acid levels

The therapeutic uses of Acacia Senegal gum for treatment of twelve patients from gout (10 males and 2 females) took place in Atbara Teaching Hospital from October 8, 2015 to January 1, 2016. Selection of patients was based on a questionnaire and a clinical examination, Six well people also participated in this study (4 males and 2 females) as a control sample. A written consent were attained from each patient and control after explaining the purpose of this work. As Bliss described *Acacia Senegal* gum solution was prepared fresh everyday by dissolving 50 g of *Acacia Senegal* gum powder in 250 ml mineral water, and consumed orally, for 3 months [2]. Blood samples were collected, before administering *Acacia Senegal* gum and once every month. Uric acid, Urea, Creatinine, and Haemoglobin in blood was determined using standard methods.

III. RESULTS

Tables 1 shows the results of the physicochemical analysis of the nine samples from *Acacia Senegal*. Average values for moisture, ash, pH, molar conductivity at infinity dilution, Refractive index, specific rotation, water holding capacity, nitrogen, and protein equal 11.85%, 3.56%, 4.71, 356.0×10^{-4} $Sg^{-1}cm^{2}$, 1.42, -32.60^{o}, 65.94%, 0.250%, and1.630% respectively. The low standard deviation values of all physicochemical characterization indicate that there is no appreciable variation between gum samples, because all gum samples collected from some trees growth in the same soil type, condition, and there no significantly different in trees ages.

Table1 Physicochemical analysis and mineral composition of *Acacia Senegal* gum.

Physicochemical Parameters	Samples studied	References
Moisture%	(10.09 to 13.41%) 11.85 ± 0.095	(8.1 to 14.05%) 10.75 ± 1.128 [13]
Ash%	(3.11 to 3.98%) 3.560 ± 0.063	(2.75 to 5.25 %) 3.77 ± 0.679 [13]
pH value	(3.95 to 5.1) 4.710 ± 0.101	(4.3 to 5.1) 4.66 ± 0.251 [13]
Λo $Sg^{-1}cm^{2}\times 10^{-4}$	(345 to 378) 356.0 ± 0.030	-

Refractive index	(1.32 to 1.49) 1.420 ± 0.048	-
Sp. Rot(degree)	(-31 o to -33.9) -32.60 ± -0.032	(-23 o to -39) -31.3 ± 3.63 [13]
W. H. Capacity %	(61.56 to 66.43 %) 65.94 ±0.11	(66.43 to 45.43 %) 67.63 ±0.64 [14]
Nitrogen%	(0.19 to 0.28%) 0.250 ± 0.145	(0.22 to 69.7 %) 0.30 ± 0.07 [13]
Protein[(a)] %	(1.25 to 1.85 %) 1.630 ± 0.146	(1.452 to 2.508 %) [(a)]1.98 [13]
Tannin%	Nil.	Nil.
Na % (w/w)	(0.021 to 0.047) 0.032 ± 0.362	0.03 [15]
K % (w/w)	(0.040 to 0.071) 0.055 ± 0.206	0.4 [15]
Ca % (w/w)	(0.591 to 0.773) 0.658 ± 0.086	0.5 [15]
P (ppm)	(1.711 to 2.513) 2.079 ± 0.014	3.2 [16]

All values are expressed as (range) mean± standard deviation; **(a)** protein content was determined by multiplying nitrogen percent by the Anderson factor 6.6; Nill = Not detected.

Table1 shows that the mean values of calcium, potassium , and sodium equal 0.032, 0.055, and 0.658 % (w/w) respectively, this indicates that the *Acacia Senegal* gum is a salts of calcium, and potassium. This result agrees with the result reported in FAO food and nutrition paper 52 include in its definition of Gum Arabic that it consists mainly of high molecular weight polysaccharides and their calcium, and potassium salts [17]. Trace amounts of phosphorus was also detected. However, most elements are soil dependent, there for their amounts are expected to increase or decrease according to the soil type.

Table2 and Figs 2 to 9 show the effects of three months *Acacia Senegal* gum treatment on Uric acid, Urea, Creatinine, and Haemoglobin concentration in gout patients and normal subjects. Table2 and Figs1 and 2 show a reduction in Uric acid concentration, in both male and female patients using 50 g per day dose for three months. Fig.2A shows that for males patients of ages less 40 years namely M1, and M2, the effect of *Acacia Senegal* gum on Uric acid levels ranged between 15.2 to 4.9 mg / dl, and 7.7 to 5.7 mg / dl , with percentage reduction 67, and 26% respectively. Uric acid was dropped to values equal the normal range after three months. Fig. 2 B and C show Uric acid levels in patients M3, and M4 decreased by 46, and 15.0% respectively, for patient of age between 40 to 50 years, uric acid levels dropped below the normal range after two months, while patient of age between 50 to 60 years Uric acid dropped to normal range after three months. Fig.2D shows blood Uric acid concentration in patients of ages up to 60 years namely M5, M6, M7, and M8 decreased by 10, 8.0, 43, and 13 % respectively, for all patients in this group Uric acid levels were decreased but after three months remained upper the normal range. This was probably due to the fact that patients in this groups were a gout patients with chronic renal failure.

Table 2 The influence of three months *Acacia Senegal* gum treatment on blood Uric acid, Urea, Creatinine, and Hemoglobin, concentration in patients and control subjects.

Parameter	Gender	Male / Patients												Female / Patients			
	Age	< 40 yrs			40 < 50 yrs		50 < 60 yrs		≥ 60 yrs					40 < 50 yrs		50 < 60 yrs	
	Visit	M1	M2	control	M3	control	M4	control	M5	M6	M7	M8	control	F1	control	F2	control
Uric Acid (mg/dl)	1st	15.2	6.7	4.9	10.6	10.8	9.2	8.5	7.6	6.1	12.6	16.2	5.4	7.2	5.4	8.9	7.3
	2nd	13.1	7.7	5.1	17.7	9.60	9.6	7.9	6.2	8.0	13.3	18.7	5.1	5.5	4.9	8.7	7.1
	3rd	7.6	6.9	4.9	10.6	11.2	9.0	8.0	8.0	8.5	9.1	15.2	6.2	4.9	5.1	7.7	6.9
	4th	4.9	5.7	5.3	9.5	11.0	8.2	7.8	7.2	7.8	7.6	16.2	4.6	4.5	4.6	7.3	7.1
Urea (mg/dl)	1st	131	123	90	195	87	184	198	94	125	184	150	95	132	98	94	83
	2nd	130	127	74	262	82	188	176	103	127	187	142	92	123	97	87	79
	3rd	123	124	86	221	76	172	179	136	179	180	136	97	120	95	79	75
	4th	111	110	102	155	91	169	182	95	154	175	150	89	110	98	65	69
Creatinine (mg/dl)	1st	1.9	1.0	0.52	7.4	5.8	6.7	6.7	7.0	0.9	4.9	4.3	4.1	5.3	4.4	7.0	4.1
	2nd	1.2	2.0	0.56	8.3	6.1	6.9	6.4	3.7	1.0	5.1	7.8	3.7	4.8	3.7	6.6	3.9
	3rd	0.9	1.4	0.5	7.0	6.3	5.2	6.0	4.5	2.0	4.8	5.6	4.0	3.9	4.1	6.2	3.5
	4th	0.7	0.9	0.47	6.1	5.5	4.9	5.9	6.0	1.4	3.2	4.3	3.5	4.2	3.5	5.6	3.8
Haemoglobin (%)	1st	82	61	81	83	77	65	60	78	61	85	89	83	65	80	65	82
	2nd	78	92	77	79	74	60	62	78	82	83	79	85	75	85	67	83
	3rd	86	87	79	85	74	73	63	57	87	87	73	83	79	89	69	88
	4th	91	95	79	87	76	75	66	80	85	88	91	88	81	98	78	87

Fig.3 Shows that blood Uric acid concentration in female patient of age between 40 to 50 years (F1) ranged from 7.2 to 4.5 mg /dl with decreases 38% , and Uric acid levels dropped to normal range after two months, while, for female patient of age between 50 to 60 years (F2) Uric acid ranged from 8.9 to 7.3 mg / dl with reduction 18% . Uric acid dropped to normal value at 50g dose a day of *Acacia Senegal* gum after three months. Normal levels of Uric acid are 5.8 to 7.4 mg/dl. Elevated serum uric acid concentrations greater than 7.4 mg /dl causes Urate crystals (Tophi) to develop with time causing, in the long run, impaired renal function, and osteoarthritis [9].

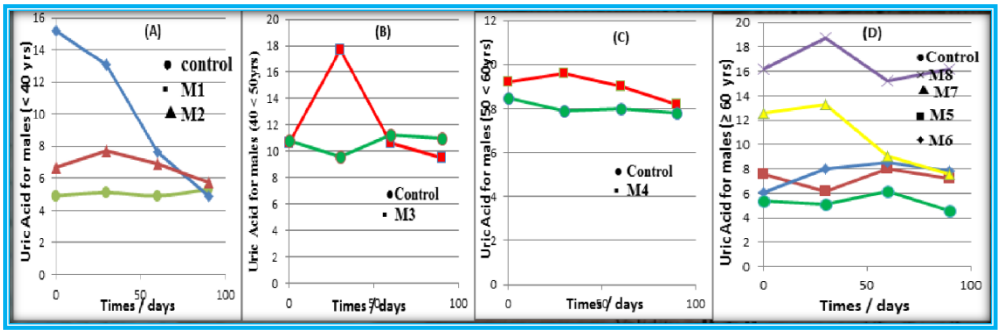

Fig.2 Variation of Uric Acid levels for Males Patients of different ages treated with gum and compared with control subject

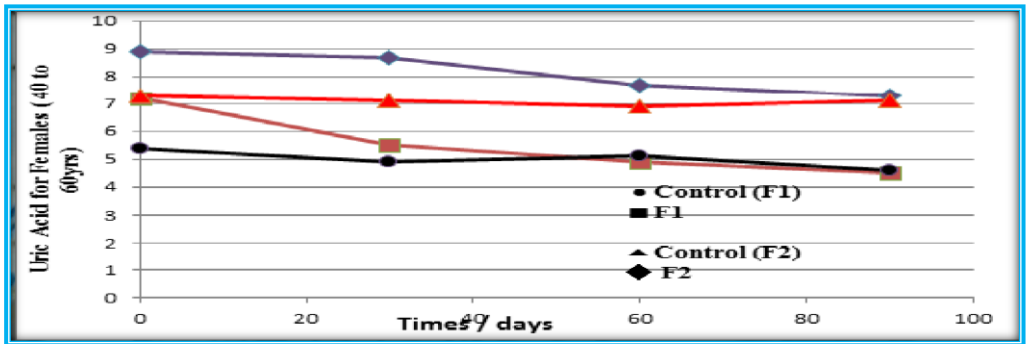

Fig.3 Variation of Uric Acid levels for Females Patients of different ages treated with gum and compared with control subject.

As indicated in Table 2 and Figs 4 and 5 Blood Urea concentrations showed a significant decrease in the three months after treatment in the gum users groups (< 40 years, 40 >50 years, 50 > 60 years, and ≥ 60 years). Figs 4A to C Showed a reduction in Urea concentration, in male patients of ages less than 40 years namely M1, and M2 using oral 50g a day dose, in the order of 15, and 13 % respectively, in order 41, and 10 % for patient of age 40 to 50 years namely M3, and patient of age 50 to 60 years namely M4 respectively. Fig.4D

Shows that Urea levels significantly decreased by 30, 14, 6.0, and 9.0 % for group patients of age up to 60 years namely M5, M6, M7, and M8 respectively.

Fig.5 Shows that the concentration of Urea in female patient of age between 40 to 50 years namely F1 ranged from 132 to 110 mg /dl with decreases 17 % , and Urea levels dropped to normal range after two months, while, for female patient of age between 50 to 60 years namely F2 ranged from 94 to 65 mg / dl with reduction 31% . Urea dropped to normal range at 50g dose per day of *Acacia Senegal* gum after three months.

The theory behind this is that a daily dose of 50 g per day of *Acacia Senegal* gum would about double the amount of energy available to the colonies of bacteria that ferment dietary fibers and absorb nitrogen as they grow. They are also capable of degrading urea to ammonia, excreting it in faeces and taking some of the body nitrogen waste with them [2]. The amount reduced varied considerably and, directly, with the gum dose over the same period. However, it remained almost constant for the control group; this result agree with Bliss et al. (1996) [2]. Who suggested that colonic bacteria are largely responsible for the decreases in serum urea nitrogen. It was also assumed that Fermentable fiber, such as gum Arabic, provides an energy substrate for bacterial nitrogen incorporation and growth.

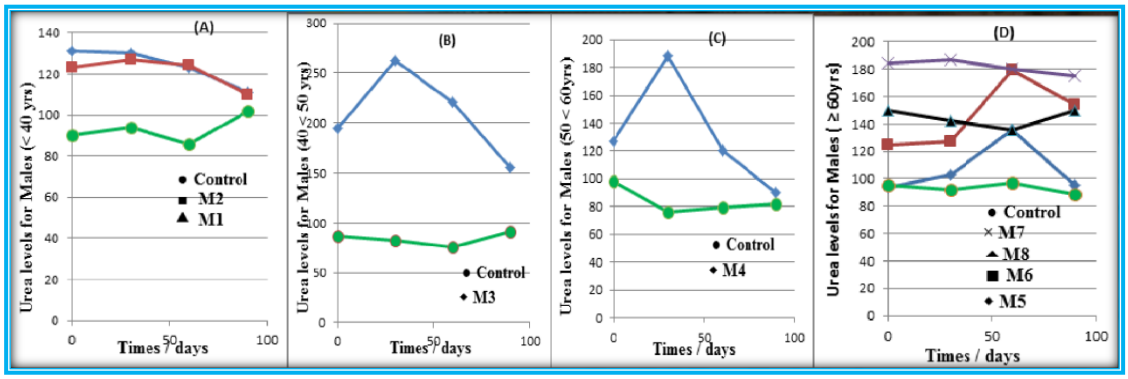

Fig.4 Variation of Urea levels for Males patients of different ages treated with gum and compared with control subject

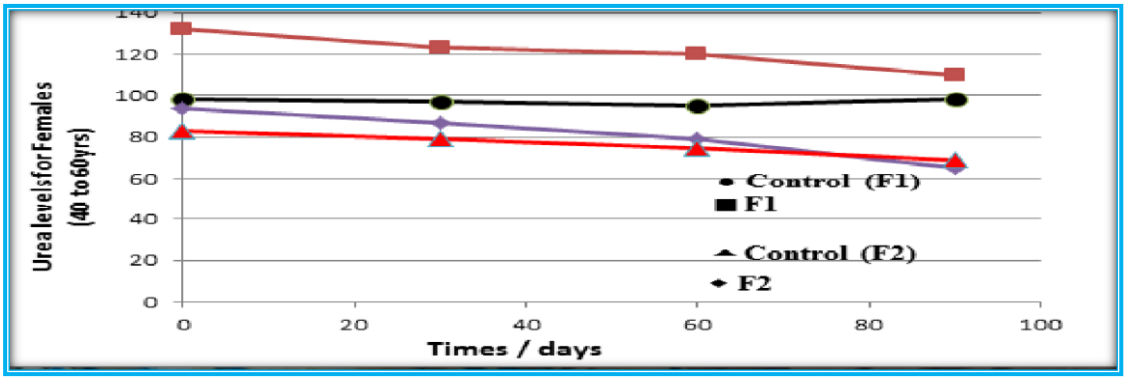

Fig.5 Variation of Urea levels for Females patients of different ages treated with gum and compared with control subject.

Fig. 6D shows that Creatinine levels significantly decreased by 35, and 45 % for group patients of age up to 60 years namely M7, and M8 respectively, while for patients namely M5, and M6 there is no statistically significant results obtained. Fig.7 shows that the concentration of Creatinine in female patient of age between 40 to 50 years namely F1 ranged from 5.3 to 4.2 mg /dl with decreases 21 % , and Creatinine levels were dropped to normal range after two months, while, for female patient of age between 50 to 60 years namely F2 ranged from 7 to 5.6 mg / dl with reduction 20% . Creatinine levels are consistent with those reported by Amira (2003) [18]. This significant decrease may also be due to the action of human colonic bacteria, which ferment *Acacia Senegal* gum, multiply and obtain their nitrogen requirement from the host's nitrogen waste product. The same results were reported by others authors [19,20].

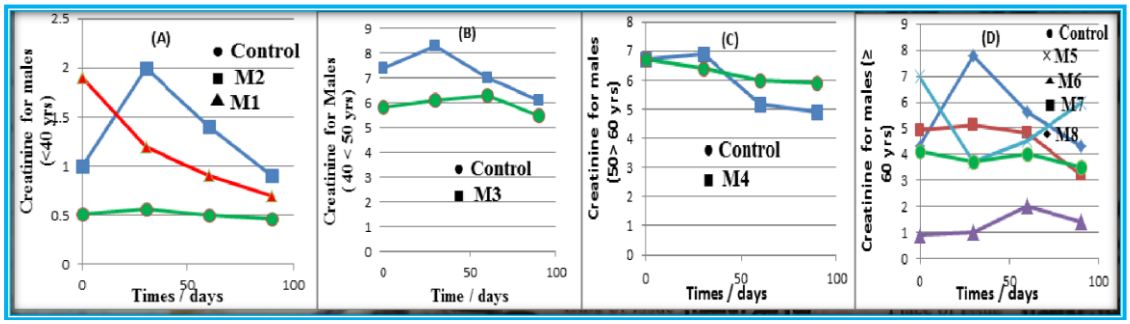

Fig.6 Variation of Creatinine levels for Males patients of different ages treated with gum and compared with control subject.

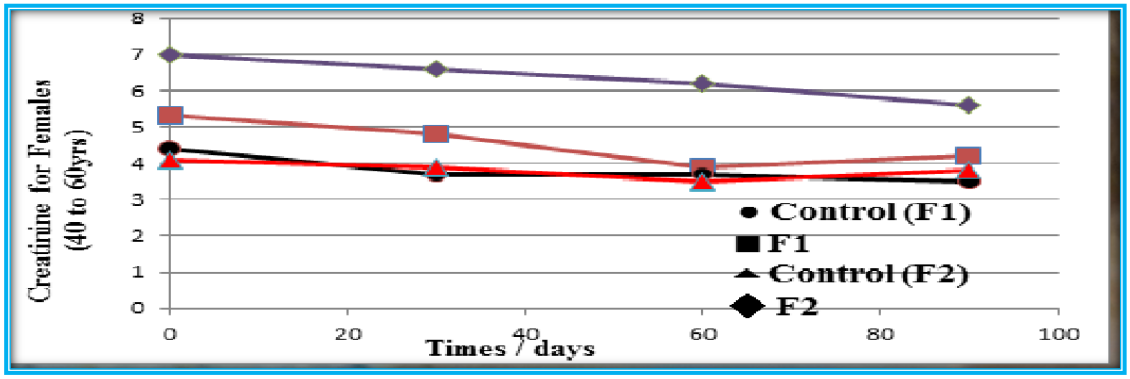

Fig.7 Variation of Creatinine levels for Females patients of different ages treated with gum and compared with control subject.

Figs 8 and 9 show the variation levels of Haemoglobin for both males, and females patients, and compared with control subject. The Haemoglobin concentration for the control groups remained steady, while that of the patients groups increased. An increase in Haemoglobin level in the blood appeared when both creatinine and urea concentrations decreased. [21]. The results show a similar increase of Haemoglobin in patients using 50 g dose per day by 14, 36, 9.0, 20, 29, 30 , 6.0, and 19% for males namely M1, M2, M3, M4, M5, M6, M7, and M8 . For females patients namely F1, and F2 Haemoglobin levels increased by 18 and 17% respectively. This result is in good agreement with Ali (2005) who reported that gum Arabic increases iron binding capacity in patients suffering chronic renal failure, indicating health improving values of Gum Arabic in cases of anemia and bleeding [22].

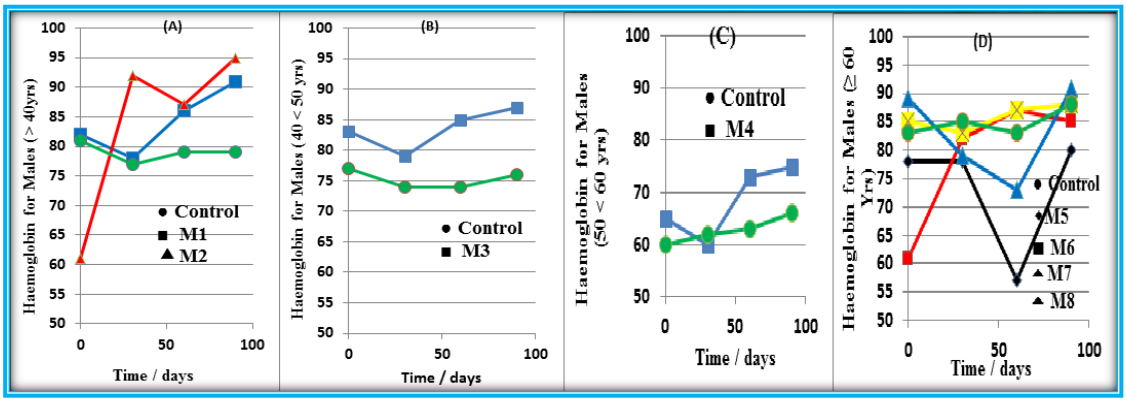

Fig.8 Variation of Haemoglobin levels for Males patients of different ages treated with gum and compared with control subject.

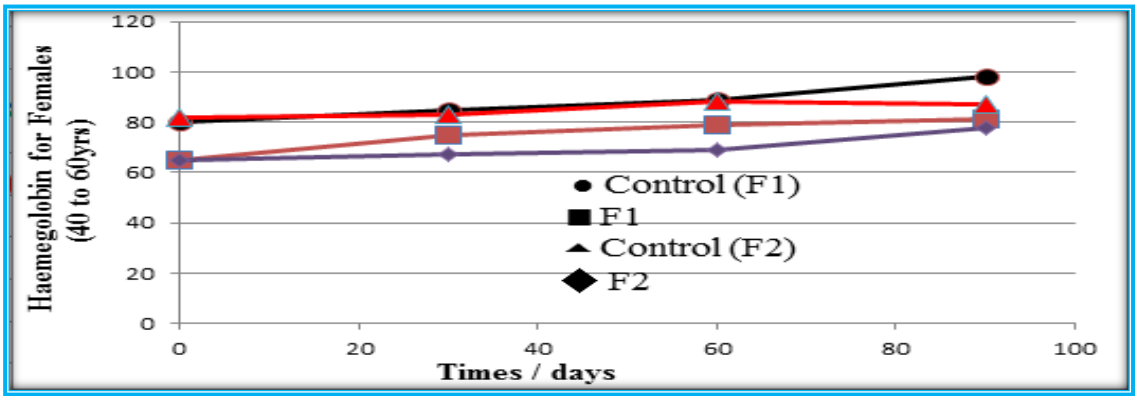

Fig.9 Variation of Haemoglobin levels for Females patients of different ages treated with gum and compared with control subject.

IV. CONCLUSION

In conclusion, our study indicated that Gout-therapy using *Acacia Senegal* gum might improve the concentration of Uric acid (mg/ dl), Urea (mg/ dl), Creatinine (mg/ dl), and Haemoglobin (%) in Serum blood of patients. For males patients namely M1, M2, M3, M4, M5, M6, M7, and M8 of different ages, Uric acid levels decreased from 15.2 to 4.9, 7.7 to 5.7, 17.7 to 9.5, 9.6 to 8.2, 8.0 to 6.2, 8.5 to 6.1, 13.3 to 9.1, and 18.7 to 16.2 % respectively, while for females namely F1, and F2 decreased from 7.2 to 4.5, and 8.9 to 7.3% respectively. The levels of Urea concentration of above males patients decreased from 131 to 111 , 127 to 110, 226 to 155, 188 to 169, 136 to 95, 179 to 154, 187 to 175, and 150 to 136% respectively, while for females namely F1, and F2 decreased from 132 to 110, and 94 to 65% respectively. Also for males patients Creatinine concentration decreased from 1.9 to 0.7, 2.0 to 0.9, 8.3 to 6.1, 6.7 to 4.9, 7.0 to 3.7, 2.0 to 1.4, 5.1 to 3.2, and 7.8 to 4.3% respectively, while for females namely F1, and F2 decreased from 5.3 to 3.9, and 7.0 to 5.6% respectively. Haemoglobin levels of above males patients increased from 78 to 91, 61 to 95, 79 to 87, 60 to 75, 57 to 80, 61 to 87, 83 to 88, and 79 to 91% respectively, while for females namely F1, and F2 increased from 65 to 81, and 65 to 78% respectively. From this study we attained that, oral administration of *Acacia Senegal* gum could conceivably reduce the gout pains by decreases levels of uric acid in the blood.

ACKNOWLEDGEMENTS

The authors are grateful to all patients and controls who volunteered to take part in this research, thanks also extended to the support of Mr. Sufian Khalid staff at Atbara Teaching Hospital – Sudan.

REFERENCES

[1]. Osman. M. E., Williams, P. A., Menzies, A. R., Phillips, G. O. and Baldwin, T.C. (1993). Carbohydr. Res., 246, 303.

[2]. Bliss, D.Z., Stein, T. P., Schleifer. C. R and Stettle, R.G. (1996). Supplementation with Gum Arabic fiber increases fecal nitrogen excretion and lowers serum urea nitrogen concentration in chronic renal failure patients consuming a low protein diet, Am J Clin. Nutr., 63. 392-398.

[3]. Abdulhakeem, A. A., , Adel, M. M., Ammar, C. A., Othman, A. A., (2002). Protective Effects of Oral Arabic Gum Administration on Gentamicin- Induced Nephrotoxicity in Rats, Pharmacological Research, Vol. 46, No. 5, 445 -451.

[4]. Assimon,S.A., Stein, T.P.(1994). Digestible fiber (gum arabic), nitrogen excretion and urea recycling in rats , Nutrition, 10, 544.

[5]. Younes H, Garleb K, Behr S, Remesy C, Demigne C. (1995). Fermentable fibers or oligosaccharides reduce urinary nitrogen excretion by increasing urea disposal in the rat cecum. J Nutr., 125, 1010-6.

[6]. Adil, A. A., Khalid E., Abdalla, A., and Khalid E. K.(2008). The effects of Gum Arabic oral treatment on the metabolic profile of chronic renal failure patients under regular haemodialysis in central Sudan, Natural Product Research, Vol. 22, No. 1, 10 January, 12-21.

[7]. Robert, K., Murray. (2003). Harper Illustrated Biochem. 6th ed. 396. Macraw Hill companies Inc.

[8]. Cameron J.S., Moro F., Simmonds, H. A.(1993). Gout, uric acid and purine metabolism in paediatric nephrology. Pediatr Nephrol, 7,105-118.

[9]. William, J. P.(1988). Clinical Chemistry,. Marshall, JB. Lippincott Company, Gower Medical, Publishing London. New York. 266-269.

[10]. Malcolm L., Brigden, M.D., B.C. (1999). Clinical Utility of the Erythrocyte Sedimentation Rate. Am. Fam. Physician, 60,1443-50.

[11]. Saunders, W. B. (1997). Fundamental of Clinical Hematology. Marcella Liffick Stevens,. Printed in United States of America.
[12]. FAO, , Rome, (1991). Food and Nutrition paper, No. 49.
[13]. Karamalla, K.A., Siddig, N.E., Osmanc,M.E.(1998). Analytical data for *Acacia senegal* var. *senegal* gum samples collected between 1993 and 1995 from Sudan, Food Hydrocolloids Volume 12, Issue 4,373-378.
[14]. Mahasin Elamin, M. Kheir.(2005). Physicochemical, functional and microbial properties of crude and processed gum arabic (*Acacia senegal*), Faculty of Science, University of Khartoum Athesis submitted to the University of Khartoum in partial fulfillment for the requirements of the degree of Master of Science (Agriculture).
[15]. Nazik, M. O.(1997). The Effect of Various Cations on Gum Arabic Viscosity, Faculty of Science, University of Khartoum A thesis Submitted in Fulfillment of the Requirement for the Degree of Master Science of the University of Khartoum.
[16]. Mahendran, T., Williams, P. A., Phillips, G. O., Alassaf, S., and Baldwin, T. C. (2008). New Insights into the Structural Characteristics of the Arabinogalactan Protein (AGP) Fraction of Gum Arabic, J. Agric. Food Chem., 56, 9269–9276.
[17]. FAO, Rome. (1998). Food and Nutrition Paper NO52: 43.
[18]. Amira, A. A. (2003). The Role of Gum Arabic as Supplementary Therapy for Chronic Renal Failure, PhD thesis, University of Khartoum.
[19]. Suliman, S.M., Hamdouk, M.I., Elfaki M.B., (2000). Gum Arabic fiber as a supplement to low protein diet in chronic renal failure patients. Sudan Association of Physicians, 17th conference, Friendship Hall, Khartoum, Sudan, March, 21-23.
[20]. Rampton, D.S., Cohen, S.L., Crammond, V.D., Gibbons, J., Lilburn, M.F., Rabet, J.Y. (1984). Clin. Nephro1., 21,159.
[21]. Makwell, M., Richard, L., John, W. (1981). Clinical Hematology, p: 492, LE and FE. BIER 600 Washinton Square Philadelphia. Pa 19106. U.S.A.
[22]. Ali, K. E. (2005). The effect of Gum Arabic oral treatment on iron and protein status in chronic renal failure patients under regular hemaodialysis in central Sudan. African j. Urology, 11, 4.

Ayat S. Hasheim, et. al. "Physicochemical Studies on Acacia Senegal Gum, and Their Effect on Uric Acid Levels in Gout Patients.."*IOSR Journal of Humanities and Social Science (IOSR-JHSS)*, 26(05), 2021, pp. 01-08.