Gum Arabic Role in High Blood Pressure among Patients with Stage III Chronic Kidney Disease

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Abstract

Gum arabic acacia is a complex, loose aggregate of Gum arabic and hemicelluloses composed of arabinic acid nucleus, it is found in nature and exists as a natural or slightly acidic calcium, magnesium, potassium or sodium salt of complex polysaccharide and the different metal ions present in gum arabic molecules. Chemically, it is an arabinose Gum arabic lactan protein complex composed by weight of 17-34% arabinose, 32-50% Gum arabic lactose, 11-16% rhamnose, 13-19% glucuronic acid and 1.8-2.5% protein. Hypertension is the most common cardiovascular disease that affects heart, brain, and hence damages blood vessels in the kidney, which leads to incidence of renal failure. So optimization of the blood pressure is beneficial for the kidney functions. This study is designed to determine the hypertension in kidney disease patients, which affect Gum arabic directly on the kidney functions, and to evaluate the changes occurred in the blood pressure in relation to gum arabic since it is rationally used in Sudan.

It is a Randomized control trial study, performed using (24) volunteers with different blood pressure readings and different kidney functions with six months past history. Dose of 10, 15, 20, 25 grams of gum dissolved in 250ml drinking water had been taken at the morning and were used for duration of 16-18 weeks with interval every four weeks, the blood pressure recorded for first as a control and pre-post every interval. The result showed systolic pressure of (146.43±28.18 before, 120.36±11.51 after) with P-value of 0.004 while the diastolic was (80.00±27.74 before, and 75.36±7.96 after), with P-value of 0.552, which showed biological rearrangement optimized referenced readings, both systolic and diastolic. Mean While the serum sodium level at that dose showed significant decrease (137.86±2.54 before, 135.00±2.04 after), with P-value of 0.003. It was concluded that there is a significant correlation between gum acacia and lowering of elevated systolic bp as well as positive correlation with serum sodium. On the other hand the correlation with diastolic blood pressure was not statistically significant.

Keywords: Gum Acacia; Blood Pressure; Salts; Renal Disease

Introduction

Gum arabic is a complex mixture of arabinose Gum arabic lactan oligosaccharides, polysaccharides, and glycoproteins. It is a branched neutral or slightly acidic substance. The chemical composition and the composition of the mixture can vary with the source, climate, season, age of trees, rainfall, time of exudation, and other factors. The backbone has been identified to consist of b-(1→2)-linked d-Gum arabic lactopyranosyl units. The side chains are composed of two to five b-(1→3)-linked d-Gum arabic lactopyranosyl units, joined to the main chain by 1,6-linkages. Both the main and the side chain contain units of:

- a-L-arabinofuranosyl,
- a-L-rhamnopyranosyl,
- b-d-glucuronopyranosyl, and
- 4-O-methyl-b-d-glucuronopyranosyl [1].

The latter two usually occur preferably as end-units.

Depending on the source, the glycan components of gum arabinose which contain a greater proportion of l-arabinose relative to d-Gum arabic lactose (Acacia seyal) or d-Gum arabic...
Gum Arabic is odorless, colorless, tasteless, and does not affect the odor, color, and taste of the system to which it is added. It is highly soluble in water and dissolves in both cold and hot water with concentrations up to 50%. The solutions exhibit Newtonian behavior at concentrations up to 40% and become pseudo plastic at higher concentration. The viscosity of solutions is highly soluble in water and dissolves in both cold and hot water with concentrations up to 50%. The solutions exhibit Newtonian behavior at concentrations up to 40% and become pseudo plastic at higher concentration. The viscosity of solutions varies strongly with the gum arabic type, pH, and ionic strength. Maximum viscosity is achieved between pH 6 and 7. Gum arabic acts as a protective colloid and excellent emulsifier. Gum arabic was also found to be a useful prebiotic, which promotes beneficial physiological effects [11]. However, the name is also used for other gums produced by other Acacia species. Despite there being more than 500 species of acacia trees, most commercial gum arabic is produced from Acacia Senegal Gum Arabic and Acacia seyal which are grown commercially throughout the Sahel from being more than 500 species of acacia trees, most commercial other gums produced by other Acacia species. Despite there being more than 500 species of acacia trees, most commercial gum arabic is produced from Acacia Senegal Gum Arabic and Acacia seyal which are grown commercially throughout the Sahel from being more than 500 species of acacia trees, most commercial other gums produced by other Acacia species.

Physico-chemical Characteristics of Gum Arabic

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systolic blood pressure was reported in this study in correlation with administration of gum arabic however lowering below the normal level was not reported and this was evident by continuity of administration of gum arabic for 18 weeks which reported stable readings without Hypotension [22]. Although insoluble fiber particles may affect viscosity measurement, viscosity is not an issue. In conclusion, our study provides good evidence of a strong association between blood viscosity and arterial pressure, independently of many possible confounding factors, summarizing the findings of the Edinburgh Artery Study, which evaluated the blood pressure/viscosity association in 1592 men and women aged 55–74 years [23]. After multivariable adjustment, total fibre intake higher by 6±8 g/4184 kJ (6±8 g/1000 kcal) was associated with a 1±69 mmHg lower systolic blood pressure (SBP; 95% CI -2±97, -0±41) and attenuated to -1±01 mmHg (95% CI -2±35, 0±34) after adjustment for urinary potassium. Insoluble fibre intake higher by 4±6 g/4184 kJ (4±6 g/1000 kcal) was associated with a 1±81 mmHg lower SBP (95% CI -3±65, 0±04), additionally adjusted for soluble fiber and urinary ‘K’ excretion. In conclusion, higher intakes of fiber, especially insoluble, may contribute to lower BP, independent of nutrients associated with higher intakes of fibre-rich foods [24]. Potassium is important in controlling blood pressure because potassium lessens the effects of sodium [25].

**Objectives**

I. To see the correlation of gum arabic with blood pressure in patients with stage III chronic Kidney disease, and the Hypertension, Which affect directly on Gum arabic which is positive on the kidney functions, and hence on the Biological balance of the cardiovascular system.

II. To evaluate the changes occurred in the Blood pressure in relation to gum arabic which composed of different acidic salts and Gum arabic proteins complex.

**Rationale of the Study**

A similar finding has recently been reported from the Central Sudan [26]. It should be emphasised however that these findings are not universally accepted and shortfalls in study design as well as studies with less dramatic effects on renal function have recently been highlighted [27]. To date, although there are numerous health claims which are made for dietary supplementation with Gum Arabic, however these are not widely accepted in clinical practice. It is clear that a structured program of clinical studies as a “proposed clinical trial protocol of Gum Arabic use in chronic kidney disease”. The dose selected to be used in the trial will be the least effective dose of Gum Arabic that lowers the serum indoxyl sulphate and increases the SCFAs concentrations, supported by good mechanistic basic science which is now needed to explore the potential health benefits of Gum Arabic, to re-establish a medical application for Gum Arabic.

**Materials and Methodology**

**Material**

Gum Acacia from Kordofan region in west Sudan was collected and prepared as required for usage in this study. Microbial test was done to get sure free of microbes (Table 1).

**Type of the study**

It is a Randomized control clinical trial study.

**Ethical consideration**

The study protocol was ethically reviewed and approved by the ethical reviewing committee of the research directorate-Federal Ministry of Health, Khartoum.

**Place of the study**

In Khartoum different Known Kidney disease centers, Salma center, Ibn Seena, Ahmed Gum arabicsim and Arif centre.

**Population of the study**

24 Kidney patients volunteers in stage III with keratinize not more than 5 and GFR 10 mls per minute with back history of six months before.

**Dosage of gum arabic**

Gum arabic was given in a building up dosage as follows for duration of 16- 18 weeks with interval every four weeks for every dose:

i. Different weights of gum arabic in instant soluble form were dissolved into 250 mls of drinking water.

ii. The weights were 10 gms, 15 gms, 20 gms and 25 gms.

iii. All the volunteers were started with the 10gm in 250ml water taken for 4 weeks.

iv. The dose was given orally in early morning on daily basis. It was then increased to 15 gms, 20 gms and finally to 25 gms each for 4 weeks interval.

v. The dose selected to be used in the trial will be the least effective dose of Gum Arabic that lowers the serum indoxyl sulphate and increases the SCFAs concentrations. A reduction of serum urea due to increased bacterial nitrogen excretion in the faeces was reported almost 20 years ago. In favor of a positive effect, work performed over 10 years ago in Khartoum, suggested beneficial effect on blood biochemistry following dietary supplementation with 50g/day in patients with CKD [28].

vi. Blood pressure was reported for each volunteer for first as a control baseline, and pre-post every dose.

The data was computed in SPSS version 20 and ANOVA was obtained.
Results

(Tables 1 & 2), (Figures 1-3).

Table 1: Results of microbial growth of the purified form in different culture media.

<table>
<thead>
<tr>
<th>No.</th>
<th>Test</th>
<th>Specifications</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Total viable aerobic count</td>
<td>Bacteria not more than $10^5$ CFU. Fungi not more than $10^5$ CFU.</td>
<td>I c/g absent</td>
</tr>
<tr>
<td>2</td>
<td>Detection of Bacteria</td>
<td>Red gram negative colonies in violet red agar</td>
<td>No growth</td>
</tr>
<tr>
<td>3</td>
<td>E. coli</td>
<td>Red non-mucoid colonies of gram negative rods in Macconkey agar</td>
<td>No growth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Indole production</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td>Salmonella typhi</td>
<td>1. Well developed of colorless colonies in deoxychocolate agar</td>
<td>No growth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2. Developed of red colonies with or without black centers on XLD agar</td>
<td>No growth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3. Small transparent colorless or pink or opaque white colonies often surrounded by a pink or red zone brilliant green agar.</td>
<td>No growth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>4. Deep growth and forming gas on triple sugar iron agar</td>
<td>No growth</td>
</tr>
<tr>
<td></td>
<td>Staphylococcus aureus</td>
<td>Growth of gram negative rods colonies on cetrmide agar</td>
<td>No growth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Black colonies of gram positive cocci surrounded by clear zone on baird parker agar.</td>
<td>No growth</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Coagulates positive</td>
<td>Negative</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Colonies surrounded with clear zone with deoxyribonucleic acid agar</td>
<td>No growth</td>
</tr>
</tbody>
</table>

Table 2: Blood Pressure reading before and after administration of gum arabic.

<table>
<thead>
<tr>
<th>Reference reading</th>
<th>Before starting</th>
<th>After 25 gms</th>
<th>P - value</th>
</tr>
</thead>
<tbody>
<tr>
<td>120-140 Systolic</td>
<td>146.43 +/- 28.18</td>
<td>120.36 +/- 11.51</td>
<td>0.004</td>
</tr>
<tr>
<td>75-90 Diastolic</td>
<td>80.00 +/- 27.74</td>
<td>75.36 +/- 7.96</td>
<td>0.552</td>
</tr>
</tbody>
</table>

Statistical Data Analysis

Were done based on mean +/- stander deviation (SD) using ANOVA statistical one way to investigate Gum arabic in the variance significance. In all analysis of data generated from in vivo studies the probability p-value 0.05 was considered as appoint for significance for both Systolic and diastolic blood pressure and other parameter Na+, K+. (Individual 95% CIs For Mean Based Pooled St-Dev) (Table 3).

Table 3: serum Na+ and K+ before and after administration of gum arabic.

<table>
<thead>
<tr>
<th>Electrolytes</th>
<th>Reference value</th>
<th>Before GA (mean +/- SD)</th>
<th>After 25 gms GA (mean +/- SD)</th>
<th>P- value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Na</td>
<td>135 -145</td>
<td>137.86 +/- 2.54</td>
<td>135.00 +/- 2.04</td>
<td>0.003</td>
</tr>
<tr>
<td>K</td>
<td>3.5 -5.0</td>
<td>4.1571 +/- 0.7377</td>
<td>5.2500 +/- 0.403</td>
<td>0.000</td>
</tr>
</tbody>
</table>

Figure 1: Systolic Blood Pressure reading before and after administration of 25gms gum arabic.

Figure 2: Diastolic Blood Pressure reading before and after administration of 25gms gum arabic.

Figure 3: Curve showing upgrading Dose effect of Gum acacia on Blood Pressure with significant lowering of the systolic and insignificance in the diastolic one. Systolic pressure of (146.43 +/- 28.18 before, 120.36 +/- 11.51 after) with P-value of 0.004 while the diastolic was (84.00 +/- 27.74 before, and 75.36 +/- 7.96 after), with P-value of 0.552.

Blood pressure showed very clear systolic decreased readings while the diastolic one is not. Meanwhile the Serum Sodium level showed significant decrease (Figures 4 & 5).
Discussion

Alteration of Blood pressure in patients with renal diseases is well documented in the literature. Gum arabic is frequently used traditionally in kidney disease. These trial findings showed positive effects in restoring the normal readings of Blood Pressure. Moreover serum sodium was also dropped in correlation with gum arabic (p value 0.003). This may also couple the drop of systolic blood pressure. On the contrary the diastolic pressure was not significantly affected. This may be related to the influence of the soluble fiber portion of gum arabic on blood viscosity. Viscosity is a physicochemical property associated with dietary fibers, particularly soluble dietary fibers. Viscous dietary fibers thicken when mixed with fluids. It includes polysaccharides such as gums, pectins, psyllium, and beta-glucans. The study showed significant association with Gum arabic administration and adjusting the readings of the BP with significant lowering (p-value 0.004), meanwhile restoring the level of serum sodium to normal values which affect directly on the Blood pressure and even serum potassium which showed significant increase up to the upper normal value (P-value 0.000). On the other hands there are no significant changes in the Diastolic Blood Pressure (P-value 0.552). Hence the upper normal range of the Systolic Blood Pressure reading is 120 and that for the Diastolic is 80, this means that for both readings the safest normal and stable range for healthy person is below (SBP 120>90) and (DBP 80>60). The kidny's ability to excrete or conserve sodium is a key factor for blood pressure regulation. Most studies show that a reduction in salt intake reduces blood pressure, the effect being greatest in those with high blood pressure, the obese and the elderly. Response to salt reduction is highly variable between individuals and may not provide measurable benefits to people already within normal BP ranges.

In contrast, reduced blood pressure is linked to increased potassium intakes which may be due to potassium’s ability to increase sodium excretion and the vasoactive effects of potassium on blood vessels. High amount of sodium in the blood stream wrecks the delicate balance, reducing the ability of the kidneys to remove the water. Increasing potassium levels helps to restore the delicate balance, this will help the kidneys to work more efficiently and helps to lower the blood pressure to a healthy level, that because potassium lessens the effects of sodium in hypertensive person. On other hands Potassium supplementation are not observed when sodium level is kept low, while Potassium is a chemical which helps to lower blood pressure by balancing out the Gum arabic effects of salt. Meanwhile low potassium in the blood causes muscles crams which leads to vasoconstrictive effect on the blood vessels, and hence elevates the blood pressure.

Conclusion

There is a significant correlation between Gum acacia and Blood Pressures as monitor with hypotensive avoidance consideration, it seems depending on the Gum components ratios. The study showed significant lowering association with Gum arabic administration and adjusting the level of serum sodium to normal values (p value 0.003) and serum potassium increase with (p value 0.000), these two factors seems to be of great value in controlling the Blood Pressure. Treatment of hypertension in CKD patients should taken into consideration. This data sheds light on a new era of Hypertension management that worth further studies. Hence long duration clinical trial (more than 4months) using dose more than 25gms and enough patient volunteers, will be beneficial to assess the sustainability of the optimum Blood pressure readings and its advantages on clinical events and kidney disease severity. This study may need further investigation on Gum arabic to establish the relationship between the amount of salts constituents in gum arabic and serum salts level.

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