# The effect of Gum Arabic on the level of plasma sodium, potassium and calcium in normal subjects

Hind Abdallah Modawi, *Rehab Mustafa Badi, Amal Mahmoud Saeed

*Physiology Department, Faculty of Medicine, University of Khartoum.*

## Abstract

**Background:** Gum Arabic (GA) is a dried exudate obtained from the stems of Acacia senegal and closely related species of Acacia. Sudan is the world's largest producer. Gum Arabic research is exploring its beneficial effect on renal and cardiac diseases. Electrolyte levels in plasma are important in the management of patients with renal and cardiac diseases. Gum Arabic contains calcium, potassium and sodium so its intake may increase the level of these electrolytes in plasma which may constitute a hazard in these patients. This research was designed to investigate the effects of GA on plasma level of these electrolytes.

**Objective:** The aim of the study was to determine the effect of GA on the plasma levels of sodium potassium and calcium.

**Materials & Methods:** An intervention case control study was conducted in the Faculty of Medicine, University of Khartoum. Twenty nine subjects and 22 controls completed the study. All were normal females aged 16 -26 years. The intervention group consumed 30 grams of GA daily for eight weeks. The dose was divided equally into two: morning and evening. The levels of $K^+$, $Na^+$, and $Ca^{++}$ were measured before and after the 8 weeks in both intervention subjects and controls. $K^+$ and $Na^+$ levels were measured using flame photometry and $Ca^{++}$ level was measured by colorimetric method.

**Results:** No significant change occurred in the plasma levels of all the electrolytes tested.

Plasma $K^+$ level changed from 3.7 ± 0.42 to 3.6 ± 0.30 mmol/L (mean ± SD) in the intervention group and from 3.7 ± 0.40 to 3.7 ± 0.42 mmol/L in the control group (p= 0.36 ).

Plasma level of Na+ changed from 130 ± 7.2 to 130 ± 4.3 mmol/L (mean ± SD) in the intervention group and from 130 ± 5.6 to 130 ± 5.0 mmol/L in the control group (p= 0.9).

Plasma level of Ca++ changed from 9.1 ± 0.56 mg/dl to 9.9 ± 0.47 mg/dl within the intervention group ,while in the control group the level changed from 9.3 ± 0.45 mg/dl to 9.61 ± 0.45 mg/dl (p=0.053).

**Conclusion:** Consumption of GA for up to 8 weeks didn't adversely affect the level of electrolytes in normal subjects. However, its use in patients suffering from renal or cardiac diseases should be subjected to further studies.

***Corresponding Author:** Physiology Department, Faculty of Medicine, University of Khartoum.*

*E-mail: rehabadi@gmail.com*

## Introduction:

Gum Arabic is edible, dried, gummy exudates from the stems and branches of Acacia senegal and Acacia seyal that is rich in non-viscous soluble fiber. It is defined by the FAO/WHO Joint Expert Committee for Food Additives (JECFA) as "a dried exudation obtained from the stems of Acacia senegal or closely related species of Acacia (family Leguminosae)" [(1)].

Sudan is the world's largest producer, followed by many other African countries. Gum Arabic readily

dissolves in water forming a solution characterized by low viscosity. This allows its use in various applications in food industry[2]. GA is indigestible to humans and animals, but its fermentation in the colon produces short-chain fatty acids (SCFA). These SCFA, specially butyrate, were found to have a wide range of health benefits[3]. The health beneficial effects of GA include: its prebiotic effect, reduction in plasma cholesterol level in animals and humans, anti-carcinogenic effect and anti-oxidant effect with a protective role against hepatic and cardiac toxicities. In addition to that, it has been claimed that GA slows the deterioration of patients with chronic renal failure. However, further studies are needed for confirmation[2].

Furthermore, it was found to have other effects such as: delaying gastric emptying, increasing fecal bulk and frequency of bowel movements by regulating colonic transit time. GA also slowed glucose absorption from the small intestine with reduction of postprandial blood glucose, serum total cholesterol and low density lipoproteins (LDL)[4].

GA was reported to decrease intestinal SGLT1 expression and activity and thus to counteract glucose-induced obesity[5].

Potassium is required for normal cellular functions. Relatively small changes in the concentration of extracellular $K^+$ greatly affect the extracellular: intracellular $K^+$ ratio and thereby affect neural transmission, muscle contraction, and vascular tone[6].

Sodium is the principal cation of the extracellular fluid and functions as the osmotic determinant regulating extracellular fluid volume and thus plasma volume. Sodium is also an important determinant of the membrane potential of cells and the active transport of molecules across cell membranes.

Calcium is found mainly in bones and teeth; only1% is found in the blood and soft tissue. The body will demineralize bone to maintain normal blood $Ca^{++}$ level when calcium intake is inadequate. Thus, adequate dietary $Ca^{++}$ is a critical factor in maintaining a healthy skeleton [7].

Gum Arabic contains $Ca^{++}$, $K^+$ and $Na^+$. In a previous study, when comparing a 10% solution of GA to tap water, the concentrations of $Ca^{++}$, $K^+$ and $Na^+$ were found to be 13.5± 1 mmol/L, 16.7± 1.2 mmol/L ,1.8± 0.6 mmol/L respectively in GA solution while they were 2.3± 0.1 mmol/L, 0.02± 0.003 mmol/L, 0.6± 001mmol/L in tap water[8]. This indicated a marked increase in the concentration of these electrolytes in GA solution.

Gum Arabic research is now investigating its beneficial effects on patients with cardiac and renal diseases in which electrolyte control is necessary. So, taking a solution with high concentration of these electrolytes may be hazardous in these patients. This study investigated the effect of GA intake on electrolyte concentration in plasma

## Materials and Methods:

This study was conducted at the Physiology Department, Faculty of Medicine, University of Khartoum. The population selected was healthy female medical students in the University of Khartoum. Their age varied between16 to 26 years.

Subjects were volunteers who willingly signed their informed consent forms. The participants were divided randomly into intervention group and controls.

The intervention group received 30mg\day of gum Arabic for 8 weeks based on our finding in other published research[2] This was divided into 15mg at morning and 15mg at evening. Each dose was reconstituted in 400 ml of water. The control subjects did not receive GA. All participants were on their usual diet.

Fifty three intervention subjects and 27 controls have been included in the study, but only 29 intervention subjects and 22 controls have completed the study due to variable reasons but none was due to side effect of GA.

Blood samples were collected early morning after overnight fast. Plasma was separated and the concentration of $Na^+$ and $K^+$ were measured using the flame photometer, while $Ca^{++}$ levels were determined using colorimetric method.

The data were analyzed using computed SPSS program, using one way ANOVA & paired T-test.

## Results:

No significant change occurred in the levels of electrolytes tested.

$K^+$ level changed from 3.7 ± 0.42 to 3.6 ± 0.30 mmol/L(mean ± SD) in the intervention group and from 3.7 ± 0.40 to 3.7 ± 0.42 mmol/L in the control group( p= 0.36 ).

$Na^+$ level changed from 130 ± 7.2 to 130 ±4.3 mmol/L in the intervention group and from 130 ± 5.6 to 130 ± 5.0 mmol/L in the control group (p= 0.9 ).

$Ca^{++}$ changed from 9.1 ± 0.56 to 9.9 ± 0.47 mg/dl in the intervention group. While in the control group the level changed from 9.3 ± 0.45 to 9.614 ± 0.45 mg/dl( p= 0.053).

## Discussion:

It was reported that GA solution is rich in $Na^+$, $k^+$ and $Ca^{++}$ [8] so its intake might increase the levels of these electrolytes in plasma and disturb their control. This is particularly important in patients with cardiac or renal disease. This study showed that there was no significant change in the plasma levels of $Na^+$, $K^+$ and $Ca^{++}$ when GA was used daily for a period of 8 weeks by healthy subjects.

A study done on mice reported that, treatment with GA significantly increased plasma sodium but had no effect on plasma $Ca^{++}$ and K+ .The intestinal and renal excretion of $Ca^{++}$ , as well as the urinary excretion of $Na^+$ were both increased in that repor [8]

From this study, we could conclude that consumption of GA did not adversely affect the level of electrolytes in normal subjects, and could be used safely without fear of affecting electrolyte levels. The only reported side effects were: nausea, mild diarrhea and bloating of the abdomen in the first week of GA consumption. However, its effect on these electrolytes in critical patients suffering from renal or cardiac diseases should be studied.

## References:


1. Ali BH, Al-Qarawi AA, Haroun EM, Mousa HM. The effect of treatment with gum Arabic on gentamicin nephrotoxicity in rats: a preliminary study. *Renal failure*. 2003;25:15-20.
2. Babiker R, Merghani TH, Elmusharaf K, Badi RM, Lang F, Saeed AM. Effects of Gum Arabic ingestion on body mass index and body fat percentage in healthy adult females: two-arm randomized, placebo controlled, double-blind trial. *Nutrition journal 2012*;11:111.
3. Phillips AO PG. Biofunctional behaviour and health benefits of a specific Gum Arabic. *Food Hydrocolloids* 2011; 25;165–9.
4. DODI LA-ES-G. The prebiotic effects of a new mixture of soluble fermentable fibres in the treatment of chronic constipation. *Pelviperineology* 2009;28 55-8.
5. Nasir O, Artunc F, Wang K, Rexhepaj R, Foller M, Ebrahim A, et al. Downregulation of mouse intestinal Na(+)-coupled glucose transporter SGLT1 by gum arabic (Acacia Senegal). *Cell Physiol Biochem2010;*25:203-210.
6. Food and Nutrition Board IoM. Dietary Reference Intakes for Water, Potassium, Sodium, Chloride, and Sulfate. (National Academies Press) 2005:269-423.
7. Weaver CM HR. Calcium. Modern Nutrition in Health and Disease. 1999;9th ed:141-55.
8. Nasir O, Artunc F, Saeed A, Kambal MA, Kalbacher H, Sandulache D, et al. Effects of gum arabic (Acacia senegal) on water and electrolyte balance in healthy mice. *J Ren Nutr.* 2008;18:230-238.