Specification and some properties of *Acacia mellifera* Gum

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ABSTRACT

This study aims to investigate and determine the physical and chemical specifications some of *Acacia mellifera* gum, as well as to analyze its functional properties, in order to evaluate its potential for industrial use and explore its viability as an alternative or complementary material to traditional Arabic gum in different applications. of *Acacia mellifera* gum were collected, as natural exudates, from two locations, Elshawa White Nile state and Umm Hegliga ELgezera state. Composite samples were analysed, the results show that, the moisture content of amean value of Elshawa 10.29% while Umm Hegliga amean value 10.63%, Specific optical rotation amean value (-35.6, -43.2), the nitrogen content was a mean value (0.7 %, 0.8 %), and protein content a mean value (10.04% , 10.44 %). representing each location viscosity were used Concentration (10,15 g/dl) to prepare. The results show that the *Acacia mellifera* gum in White Nile State and Gezira State is similar flow curves of gum solution were shown. The *mellifera* gum medium Specification and viscosity properties in comparison with the result for *Acacia* gum the other.

Keywords: Specification Viscosity properties mellifera gum

المستخلص

تهدف هذه الدراسة لتحديد بعض المواصفات الفيزيائية والكيميائية لصمغ أكاشيا الميليفيرا، وكذلك تحليل خصائصه الوظيفية، من أجل تقييم إمكاناته للاستخدام الصناعي واستكشاف مدى ملاءمته للصمغ العربي التقليدي في تطبيقات مختلفة كبديل أو مادة مكملة، وتم جمعه من موقعين مختلفين، ولاية النيل الأبيض الشاوة وولاية الجزيرة أم هجليجة تم أستخدام العينات كل عينة مكونة من مجموعة عينات المنطقة وأظهرت النتائج أن متوسط قيم الرطوبة لشاوة 10.29% وام هجليجة 10.63%, ، متوسط قيم الدوران الضوئي النوعي (-35.6, -43.2) ، متوسط قيم محتوى النيتروجين (0.7 %, 0.8 %) ، متوسط قيم محتوى البروتين (10.04% , 10.44 %). علي التوالي و اللزوجة بتراكيز (10,15 g/dl) لمعرفة خواصها. ، وأظهرت النتائج أن صمغ أكاشيا الميليفيرا في ولاية النيل الأبيض وولاية الجزيرة متشابه ومتوسط الخصائيص و اللزوجة مقارنة بصمغ الأكاشيا الأخرى.

الكلمات المفتاحية: الخصائيص الخواص اللزوجة

INTRODUCTION

Acacia mellifera can manifest itself as a multi-trunked bush up to seven meters high with more or less a funnel-shaped crown, but also as a small single-trunked tree which can reach a height of up to nine meters. It is a gregarious plant, and commonly occurs as impenetrable thickets of

several hundred individuals in nearly pure stands, Specific rotation is considered as the most important criterion of purity and identify of gum Arabic. In the revised specifications *Acacia senegal* gum specific rotation falls within the range between -26° to -34°the word *Acacia* comes from Acantha which means thorn (3). The species name *mellifera* means honey bearing and refers to the flowers (13, 14). *Acacia mellifera* gum is a natural substance with potential applications in the food and pharmaceutical industries due to its physical and chemical properties, however there is a lack of comprehensive studies that precisely define its specifications and functional characteristics compared to other types of Arabic gum this gap hinders its optimal utilization in various industrial applications (15,16).Was used for determining the nitrogen content in organic and inorganic substances. Although the technique and apparatus have been modified over the years, the basic principle introduced by method Johan Kjeldahl are still the same AOAC (1,6). A micro Kjeldahl method was used to determine the total nitrogen in *A. torilis var. totilis* samples; the nitrogenous compound was digested with concentrated sulphuric acid in the presence of selenium and copper sulphate- potassium sulphate catalyst to yield ammonium sulphate. An excess of sodium hydroxide is added and ammonia is distilled in steam, absorbed in boric acid and titrated with hydrochloric acid using methyl red as indicator(5).

. Viscosity this interdisciplinary field encompasses many different types of materials and application, both in academia and industry (1,2). One of the most challenging and practical areas in which technical strides have been made is dispersion chemistry viscosity can be used to characterize not only flow properties of a material, but also structural features the term was coined by Eugene C.Bingham, professor at Lafayette College in 1920 (8,9). The term was inspired by the aphorism of “every things flows” Plato that saying “all things move and nothing remains still” (1,10). The reaction involved in these steps can be shown as follows;

- Sample + H_2SO_4 (conc.) + catalyst + Heat = $(NH_4)_2SO_4$
- $(NH_4)_2SO_4 + 2HaOH = 2NH_3 + Na_2SO_4 + 2H_2O$
- $NH_3 + H_3BO_3 = NH_4^+ + H_2BO_3^-$
- $H_2BO_3^- + HCL = H_3BO_3 + CI^-$

Geometries used were cone and plate for all experiments, parallel plate was used to study the flow and oscillation of crude gum. when the shear rate is increased gradually (viscosity in reduced) and when the shear rate is decreased gradually (viscosity increased) the curves show a very similar behavior(2). The shear thinning behavior may be attributed to the fact that: the

structures in the gum are most probably three dimensional coils. The shape of each coil appears to be roughly spherical and each one is entangled many times with neighboring macro molecules (1,3). During the shearing process, the molecules are oriented into the shear direction as well as the shear gradient direction, on doing so the molecules disentangle to a certain extent and this lower their flow resistance and hence increase the freedom of movement of individual chains (4). This were is identify specification parameters of *Acacia mellifera* gum. Huggins found that a plot of k versus [Ƞ]^2 was linear and pass through the origin(3). Relative viscosity is the ratio of the viscosity of the solution, Ƞsol to the viscosity of the solvent, Ƞsol. C specific viscosity expresses the incremental viscosity due to the presence of the polymer in the solution. NormalizingƞSp to concentration gives Ƞsp /c expresses the capacity of a polymer to cause the solution viscosity increase; i.e., the incremental viscosity, per unit concentration of polymer. As with other polymer solution properties, the solution used for viscosity measurements will be non-ideal and therefore Ƞsp/c will depend on c. the extrapolated value of Ƞsp/c at zero concentration is known as the intrinsic viscosity [Ƞ].Intrinsic viscosity [Ƞ] will be shown to be a unique function of molecular weight (for a given polymer-solvent pair) and measurements of [Ƞ] can be used to measure molecular weight. The remaining form for the viscosity is the inherent viscosity (8). The intrinsic viscosity has great practical value in molecular weight determination s of high polymer. this concept is based on the mark-houwink relation suggesting that the intrinsic viscosity of a dilute polymer solution is proportional to the average molecular weight of the solute raised to a power in the range of 0.5 to 0.9 values of the proportionality constant and the exponent are well known for many polymer-solvent combinations. Solution viscosities are useful in understanding the behavior of some polymer. Measurement of solution viscosity are usually made by comparing the efflux time t required for a specified volume of polymer solution to flow through a capillary tube with the corresponding efflux time t0 for the solvent. From t, t0, and the solute concentration are derived several quantities whose defining equations and names are given below.

Relative viscosity Ƞr =Ƞsol/Ƞsol = t/t0

Specific viscosity Ƞsp = (Ƞsol–Ƞsolv) /Ƞsolv =Ƞr–1

Reduced viscosity Ƞerd = Ƞsp/c

Inherent viscosity Ƞinh = ln. [Ƞred /c]

Intrinsic viscosity [Ƞ] =lim [Ƞsp/c]c—›0 =ln[Ƞred/c]c—›0…. (3)

In these equations, Ƞsol is solution viscosity, Ƞsol is viscosity of the pure solvent, and c is concentration g/dl (6, 7).

MATERIAL AND METHOD

Composite six samples of *Acacia mellifera* gum were prepared by random mixing of selected samples to represent each location. The samples were ground using mortar and pestle and kept in

separate container for analysis prepare the aims of this were is identify specification. The methodology includes international Moisture content the technique employed in this method is based simply on drying the gum to constant weight. The methodology includes international procedure was carried determination of moisture content:-this procedure was carried according to A.O.A.C(1,4, 6). Accurately 0.5 grams of *Acacia mellifera* gum samples were weighed in weighed dishes and heated at 105ºC an oven for 6 hours (to a constant weight). The moisture content was then calculated as percentage of the initial weight from the following relation

Moisture % = (W2/W1) × 100

Where W2 = weight of sample after heating

W1 = weight of sample before heating.

Determination of specific optical rotation: -

1% solution were prepared from the dry samples using distilled water, the gum solutions were mixed on a roller mixer until the sample completely dissolved, and then filtered through Watmann No.42 filter paper. Then loaded into the sample holder without trapping air bubbles. Optical rotation was measured using digital polarimeter equipped with 250 mm tube filled with the test solution at room temperature. Specific rotation was calculated by the following relation;

$[\alpha]^{1}_{D} = \alpha \bullet \frac{100}{C\iota}$ where α is the observed rotation of the solution in circular degrees, C is the grams of substance per 1 ml of solution, and ι is the length of the solution in decimeters. (14,16).

Determination of total Nitrogen and Protein % : -

0.5 gram of each sample (in duplicate) was weighed, and transferred to Kjeldahl digestion flasks, one Kjeldahl tablet (copper sulphate – potassium sulphate catalyst) was added to each. Then 10 ml of concentrated nitrogen free, sulphuric acid were added. The flask was then mounted in the digestion heating system which was heated at 245ºC, and capped with aerated manifold. The solution was then heated at the above temperature until a clear pale yellowish-green color was obtained which indicates the completion of the digestion. The flasks were then allowed to cool to room temperature, this content was quantitatively transferred to Kjeldahl distillation apparatus, and the steam distillation of the ammonia was commenced. The released ammonia was absorbed in 25 ml of 2% boric acid. Back titration of the generated borate was then carried out versus, 0.02 M, HCI using methyl red as indicator. Blank set of experiment was carried in the same way.

Determination of intrinsic viscosity:-

Acacia mellifera gum Comb1 gum solution (10g /l) was stirred overnight in roller mixer overnight. The insoluble matter was removed by centrifugation at 500g for 15min, and then the viscosity and dynamic rheological tests were performed at 25 ±0.1 ^{o}C in AR-G550 rheometer which included a circulating water bath (Julabo F10, Germany) with ±0.1 ^{o}C accuracy(9,11).

RESULTS AND DISCUSSIONS

Tables 1 and table 2 summarize the results of analytical data for gum samples *Acacia mellifera* the moisture content of White Nile state (Elshawa) samples were found to be in the range of 10.22% to 10.35%, with a mean value of 10.29% while ELgezera states (Umm Hegliga) sample ranged from 10.51% to 10.75%.With a mean value 10.63%.The results are similar to that reported by *Acacia tortilis var. raddiana* Gum (12).

. The Specific optical rotation of White Nile state (Elshawa) samples were found to be in the range of -35.2 to -36.0%, with a mean value of -35.6 while ELgezera states (Umm Hegliga) sample ranged from -37.6 to -46.1.With a mean value -43.2. The Nitrogen content of White Nile state (Elshawa) samples were found to be in the range of 65% to 80%, with a mean value of 0.7 % while ELgezera states (Umm Hegliga) sample ranged from 0.70 % to 0.95 %.With a mean value 0.8 %.The results are good agreement with those reported by (11). The Protein content of White Nile state (Elshawa) samples were found to be in the range of 9.68% to 10.32%, with a mean value of 10.04% while ELgezera states (Umm Hegliga) sample ranged from 9.96 % to 10.76 %.With a mean value 10.44 %.The results are good agreement with those reported by *Acacia tortilis var. raddiana* Gum (12).

Figures 1, 2 ,3 and 4 summarize the Viscosity performance of the composite samples Comb1 *(10,15 g/dl)* (Elshawa) and Comb2*(10,15 g/dl)* (Umm Hegliga), Viscosity properties of *Acacia mellifera* gum. The profile for variation of viscosity with shear rate: when the shear rate is increased gradually (viscosity inreduced) and when the shear rate is decreased gradually (viscosity increased) for each concentration of each sample exactly coincide and doesn't make any loop for all values of shear rate Figure 1 this indicates some sort of reversible deformation in the molecules due to the shear rate and hence assists the elastic behavior of the gum (no energy is dissipated during the shearing) at very low shear rate (0.01 – 0.1 Hz) the viscosity of the gum are almost constant for the considered concentrations (3,7,12). The Comparison of for viscosity decrease steadily with increasing shear rate till the shear rate reaches a value of (tan (y)$\frac{\delta l}{h}$. And exhibited a non-Newtonian behavior in this region; therefore, a limiting Newtonian higher-shear viscosity could be estimated by fitting the experimental results to the Sisko model (8,12). This model predicts Newtonian response at high-shear rate.

$$\pi = ksy\infty + n\infty$$

Where (n) is the apparent viscosity (Pa s), Ks (Pa s^n) and ns are the consistency index and the flow index of the Sisko model, respectively; ($\gamma\infty$) the shear rate (s^{-1}) and ($n\infty$) (Pa s) stand for the so-called infinite-shear rate viscosity. the behavior shown in Fig.2. is typical of a stable gel whose rheological behavior looks like that of a chemical gel with stable crosslink points. While Comb1 and Comb2 similar to those reported by (9,10,12).

Table 1 Specification and some properties of *Acacia mellifera* Gum from Elshawa.

Sample Comb1 No.	Moisture %	Optical rotation	Nitrogen Content %	Protein Content%
A 1	10.35	- 35.2	0.80	10.32
A2	10.29	- 35.8	0.70	09.68
A3	10.22	- 36.0	0.65	10.11
Mean	10.29	-35.6	0.72	10.04

Table 2 Specification and some properties of *Acacia mellifera* Gum from Umm Hegliga.

Sample Comb 2 No.	Moisture %	Optical rotation	Nitrogen Content %	Protein Content%
B1	10.75	- 46.0	0.90	09.96
B2	10.51	- 37.6	0.70	10.59
B3	10.63	- 46.1	0.95	10.76
Mean	10.63	-43.2	0.85	10.44

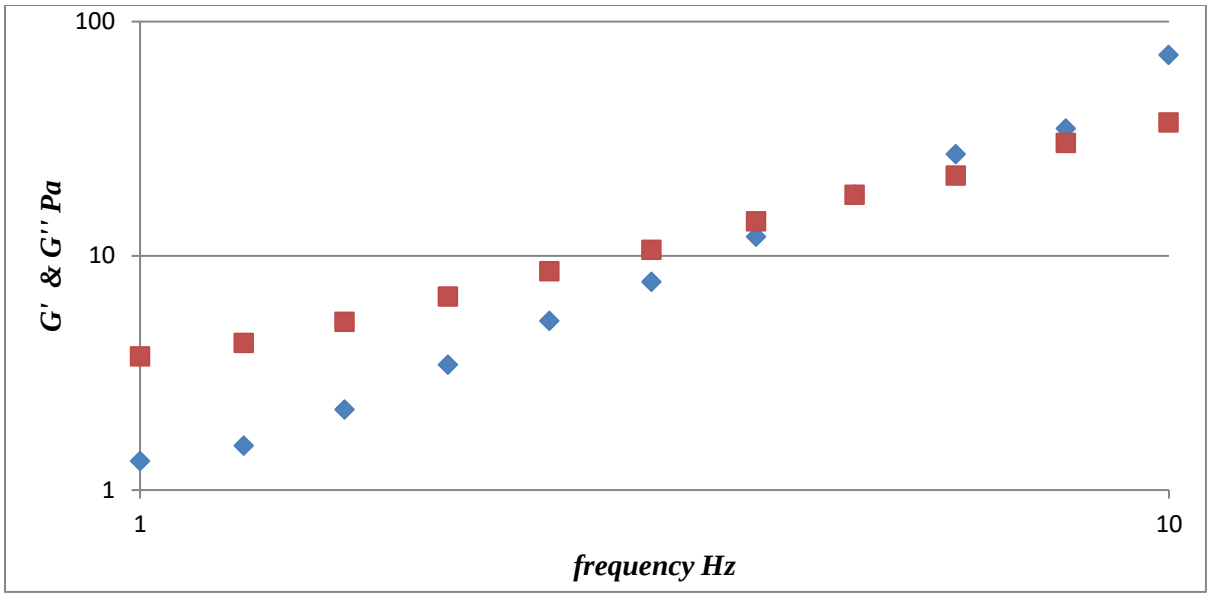


Fig.1. Viscosity Performance of sample *Acacia mellifera* gum Comb1 *(10 g/dl)* from Elshawa.

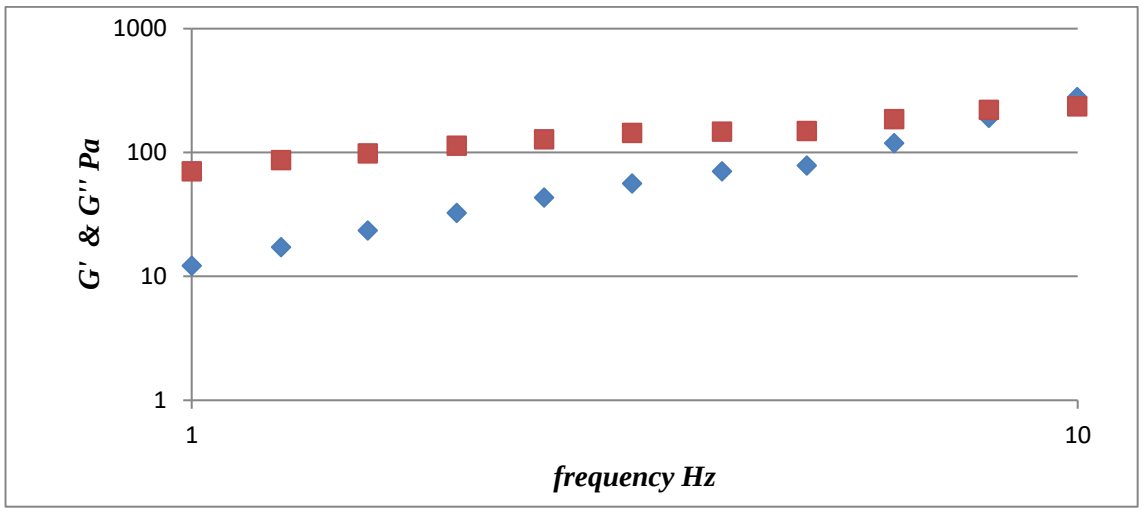


Fig.2. Viscosity Performance of sample *Acacia mellifera* gum Comb2*(10 g/dl)* from Umm Hegliga.

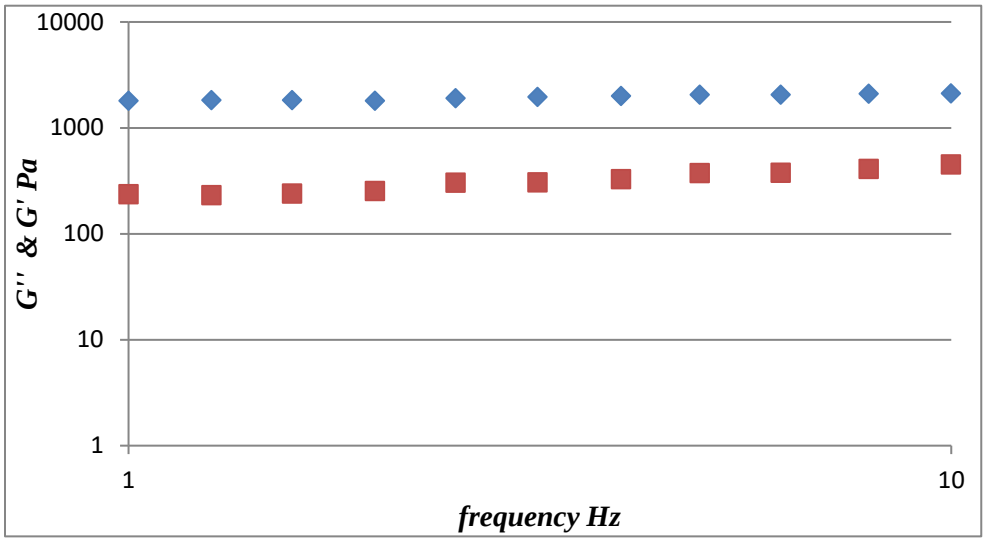


Fig.3. Viscosity Performance of sample *Acacia mellifera* gum Comb1*(15 g/dl)* from Elshawa.

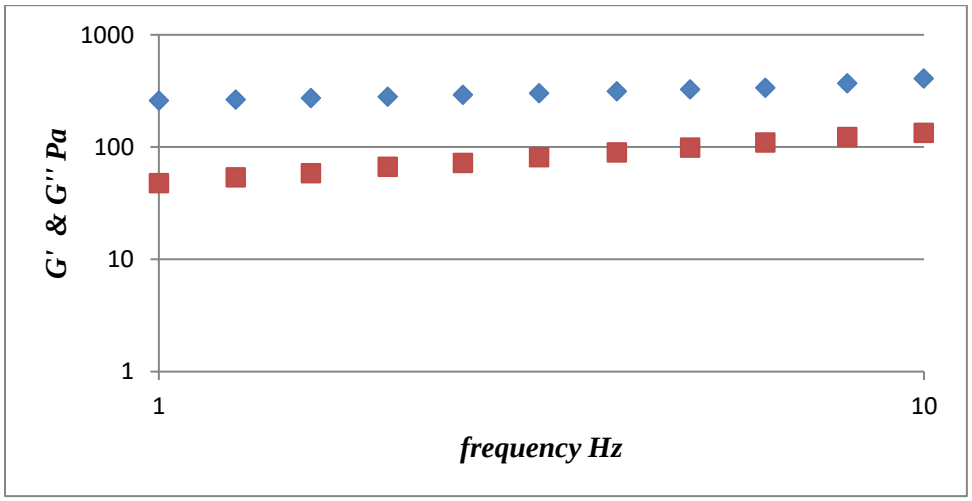


Fig.4. Viscosity Performance of sample *Acacia mellifera* gum Comb2*(15 g/dl)* from Umm Hegliga.

CONCLUSION

*This study investigated and characterized the physical, chemical and functional properties of *Acacia mellifera* gum. The findings revealed that this type of gum possesses promising characteristics that make it suitable for various industrial applications. It demonstrated good solubility, notable viscosity and emulsifying properties along with acceptable chemical and thermal.

* The gum from *Acacia mellifera* were the two locations show similar Specification.

*The gum from *Acacia mellifera* has medium protein content and viscosity in comparison with for *Acacia* gum the other (*Acacia tortilis var. raddiana* gum).

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